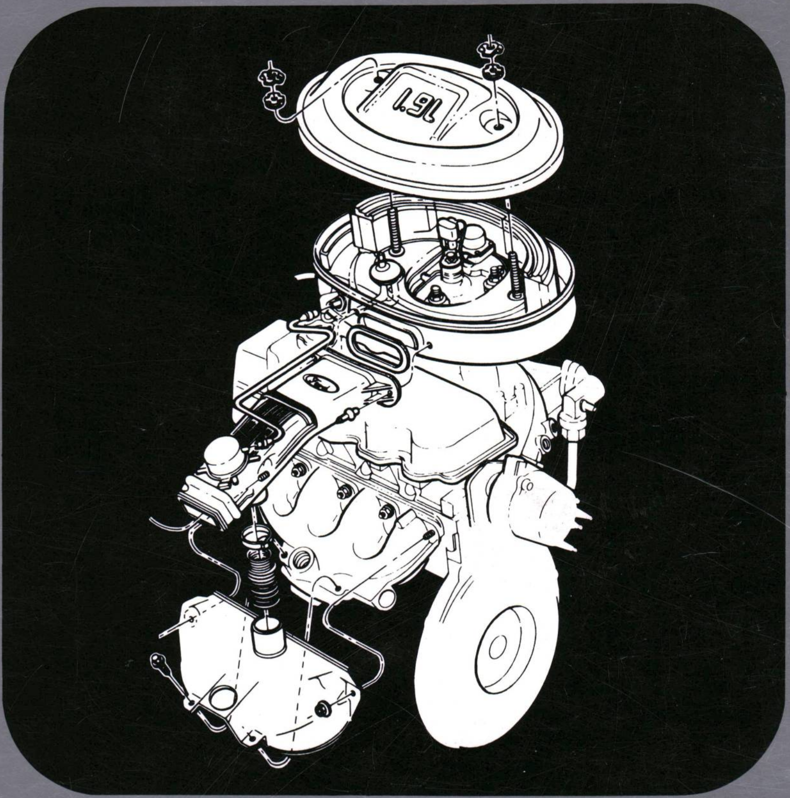
air inlet control systems



Supplement to Select STST Courses

STST

Service Technician Specialty Training

Ford Parts and Service Division
Technical Training

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as the personal safety of the individual doing the work. This manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

As you read through the procedures, you will come across NOTES, CAUTIONS, AND WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK unless instructed otherwise for a specific service operation. If you have a manual transmission, it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific service operation.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind your head.
- Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in underhood temperatures, even though the ignition is in the OFF position. Therefore, care should be taken to ensure that the electric cooling fan is completely disconnected when working under the hood.

The recommendations and suggestions contained in this manual are made to assist the dealer in improving his dealership parts and/or service department operations. These recommendations and suggestions do not supersede or override the provisions of the Warranty and Policy Manual or the Shop Manual and in any cases where there may be a conflict, the provisions of the Warranty and Policy Manual or the Shop Manual shall govern.

The descriptions, testing procedures, and specifications in this handbook were in effect at the time the handbook was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications, design, or testing procedures without notice and without incurring obligation. Any reference to brand names in this manual is intended merely as an example of the types of tools, lubricants, materials, etc. recommended for use. Equivalents, if available, may be used. The right is reserved to make changes at any time without notice.

WARNING: Many brake linings contain asbestos fibers. When working on brake components, avoid breathing the dust. Breathing the asbestos dust can cause asbestosis and cancer.

Breathing asbestos dust is harmful to your health.

Dust and dirt present on car wheel brake and clutch assemblies may contain asbestos fibers that are hazardous to your health when made airborne by cleaning with compressed air or by dry brushing.

Wheel brake assemblies and clutch facings should be cleaned using a vacuum cleaner recommended for use with asbestos fibers. Dust and dirt should be disposed of in a manner that prevents dust exposure, such as sealed bags. The bag must be labelled per OSHA instructions and the trash hauler notified as to the contents of the bag.

If a vacuum bag suitable for asbestos is not available, cleaning should be done wet. If dust generation is still possible, technicians should wear government approved toxic dust purifying respirators.

OSHA requires areas where asbestos dust generation is possible to be isolated and posted with warning signs. Only technicians concerned with performing brake or clutch service should be present in the area.

Copyright © 1988 Ford Motor Company

TABLE OF CONTENTS

INTRODUCTION 1
Purpose of This Program 1
Engine Air Requirements 2
Air Cleaner Construction 3

EVOLUTION OF AIR INLET SYSTEMS 10
Nonheated Air Inlet Systems 10
Heated Air Inlet Systems 11
System Operation 16
System Controls 21
Early Fuel Evaporation (EFE) Heater 30

CURRENT HEATED AIR INLET SYSTEMS 31
Improvements Over Early Systems 31
2.8L Computer-Controlled Inlet Air System (IAS) 35

EFFECT OF INLET AIR SYSTEM ON OTHER SYSTEMS AND CONDITIONS 39
Engine Performance 39
Fuel Control 40
Variable Voltage (Programmed) Choke 41
Carburetor Icing and Snow Packing 42

SYSTEM SERVICE 44
System Inspection and Performance Test 45
Individual Component Testing 47
Component Repair 51

GLOSSARY 52

INTRODUCTION

PURPOSE OF THIS PROGRAM

This manual takes a close and thorough look at Air Inlet Control Systems (Fig.1) used on current and past model Ford and Lincoln-Mercury vehicles. The contents of this manual primarily concerns operation, diagnosis, adjustments, and any peculiar service features that a technician should be aware of.

Normally the Air Inlet Control System is grouped together with other engine control systems. This manual though, will peer deeply into the subject and provide you with information—not just about the system itself, but how it affects other components, systems and subsystems on the vehicle. After you've finished reading this manual you will have a much better understanding of the Air Inlet Control System and be able to use this knowledge to improve your service and diagnostic abilities.

Essentially the manual concentrates on the introduction of heated air into the engine during cold weather and engine cold start conditions. This air, heated by the exhaust manifold, is extremely important to engine performance, low emissions, and good driveability. The introduction of heated air, modulation of heated and ambient air, and cutoff of heated air must all occur between specific parameters to assure optimum engine operation. It is the aim of this manual to ensure that you thoroughly comprehend this system.

The actual use of this system is found on all vehicles equipped with carburetors or central fuel injection (CFI). The heated air inlet system is used on selected port fuel injected (EFI) engines, but you will not find it used on all EFI applications.

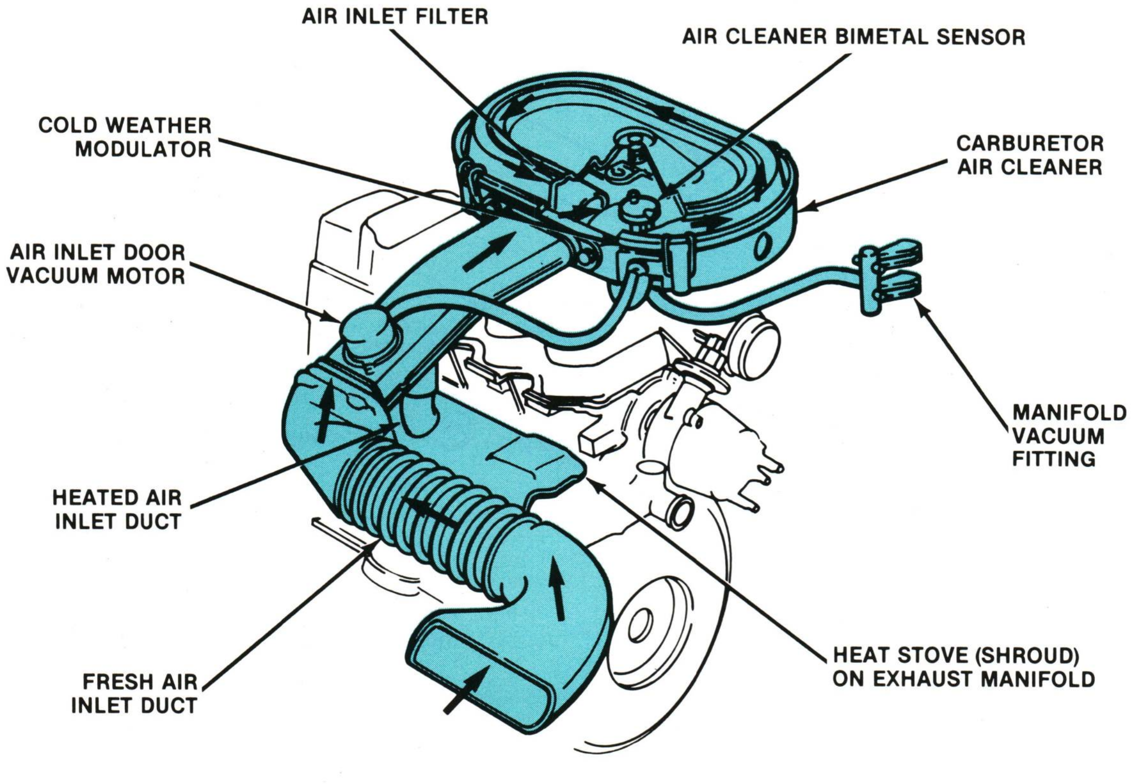


Figure 1. Air Inlet Control System

INTRODUCTION

ENGINE AIR REQUIREMENTS

To perform to its maximum potential, any engine—no matter if it's on a lawn mower or in a high performance automobile—has two basic requirements:

- Clean Air
- Clean Fuel

Our concern in this particular program is with the **Clean Air**. In addition to being clean, the air entering an engine must have two other qualities to allow for maximum performance during all phases of operation. They are:

- **Unrestricted**—There should be nothing preventing the engine from receiving all the air it needs.
- **Temperature Controlled**—Air entering the engine should be at a temperature that allows for maximum fuel atomization. This is especially important when an engine is first started and it is cold, or when driving during cold weather.

As you know, air enters the engine through the air cleaner assembly, so it is obvious that anything that has to do with letting air into the engine probably contains the air cleaner assembly as an integral component. This is true of the air inlet controls which are integral with the air cleaner assembly. Let's take a close look at this assembly to see the major components (Fig. 2).

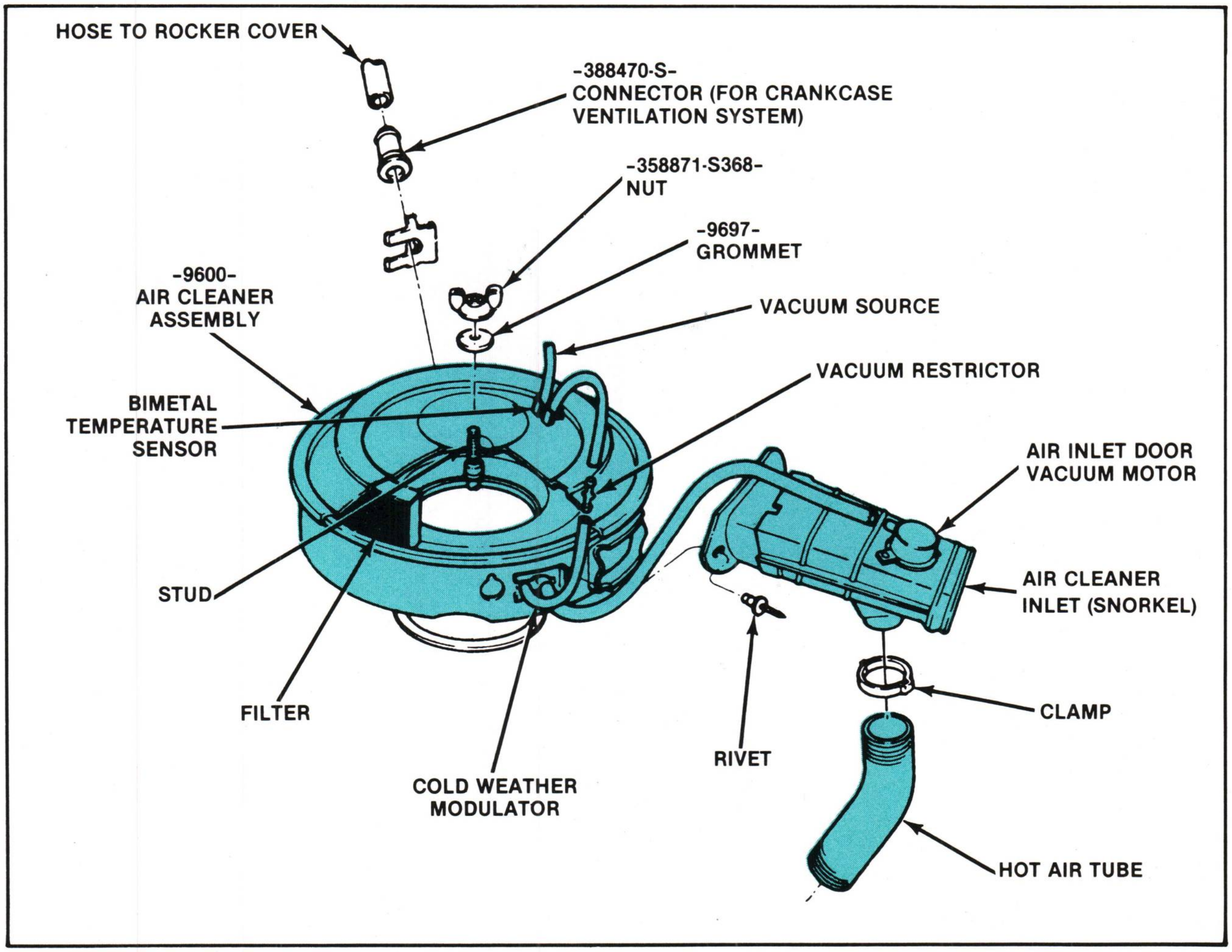


Figure 2. Air Cleaner Assembly—Major Components

INTRODUCTION

AIR CLEANER CONSTRUCTION

The major components that make up the air cleaner assembly include:

Air Cleaning Housing

Air cleaner housings come in all shapes and sizes depending upon their application (Fig. 3). Their primary purpose is to house the air filter and other components commonly associated with the air inlet control system. Note that there are two openings into the air cleaner. The first is through the snorkel. This allows ambient air to enter the air cleaner. The second is in the lower part of the snorkel. It also allows ambient air in, but only after it has passed over a heat stove on the exhaust manifold to heat it.

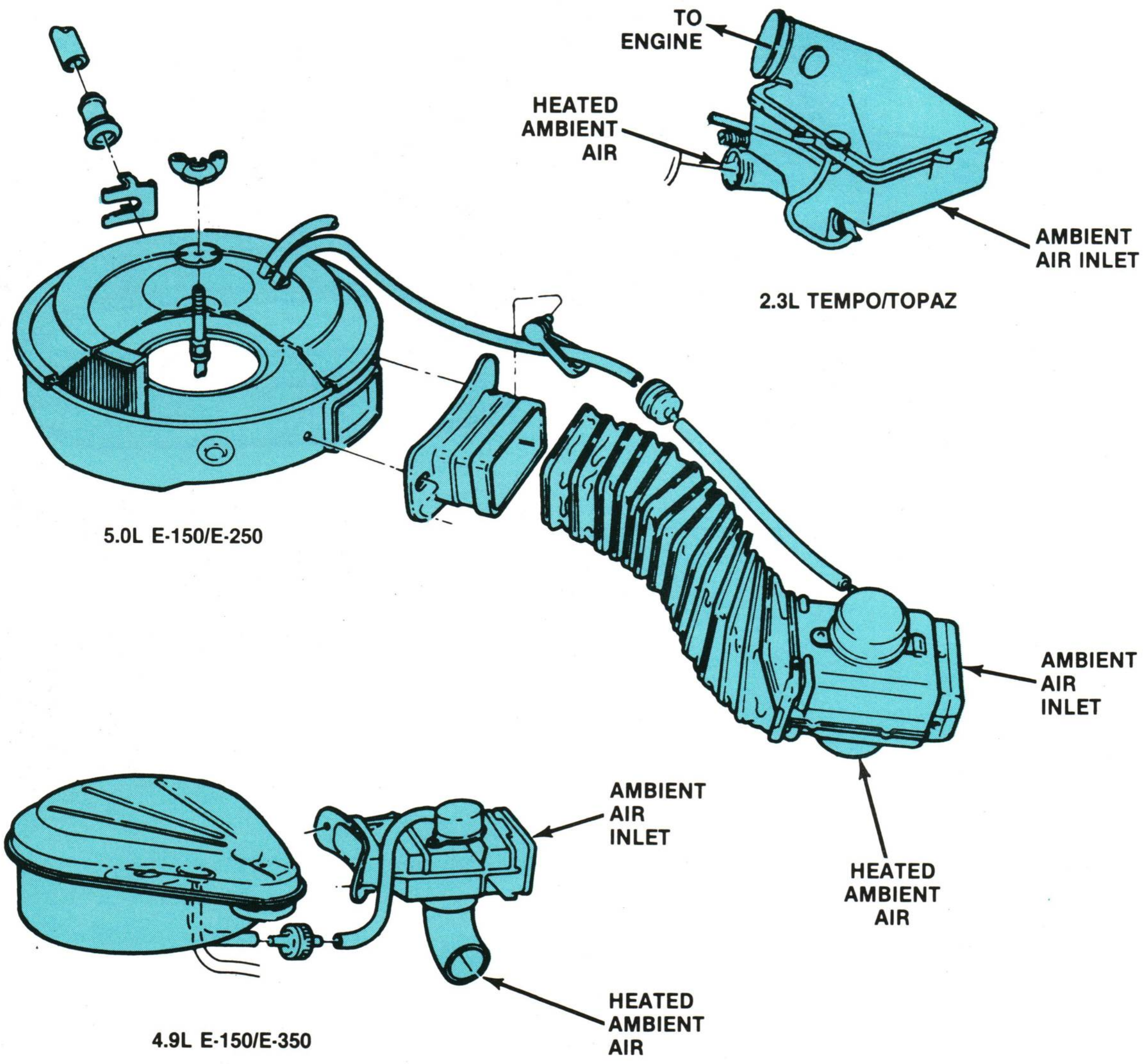


Figure 3. Air Filter Housings

Air Filter

Just like the air cleaner housing, air filters come in many different shapes and sizes depending upon their application (Fig. 4). Normally a dry-type paper element filter is used in Ford and Lincoln-Mercury automotive applications. This type of filter uses paper as the primary filtering agent. The paper is chemically treated so that it is capable of trapping dust and dirt, preventing it from getting into the engine.

Occasionally, an oil bath filter is used. This type of filter uses a filter, bathed in oil, to trap contaminants. In recent years they have seen use in truck applications, but not in automobiles.

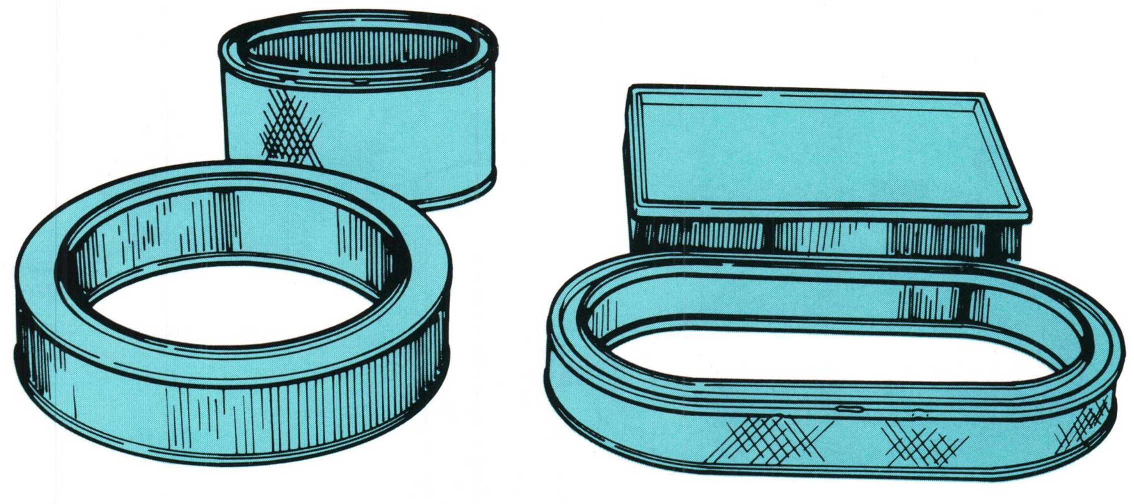


Figure 4. Air Filters

Temperature Sensor

This sensor (Fig. 5) is usually mounted on the base of the air cleaner assembly. Its function is to sense the temperature on the inside of the air cleaner. Essentially this temperature is the temperature of the air entering the engine. It is a bimetal type sensor which reacts to changes in temperature by opening or closing a vacuum passage.

You may notice that some air cleaners have more than one bimetal sensor (Fig. 6). One is for the operation of the vacuum motor for the heated air inlet system. The other is for some other engine control device. Be sure that if you are replacing a bimetal sensor that it is the correct one.

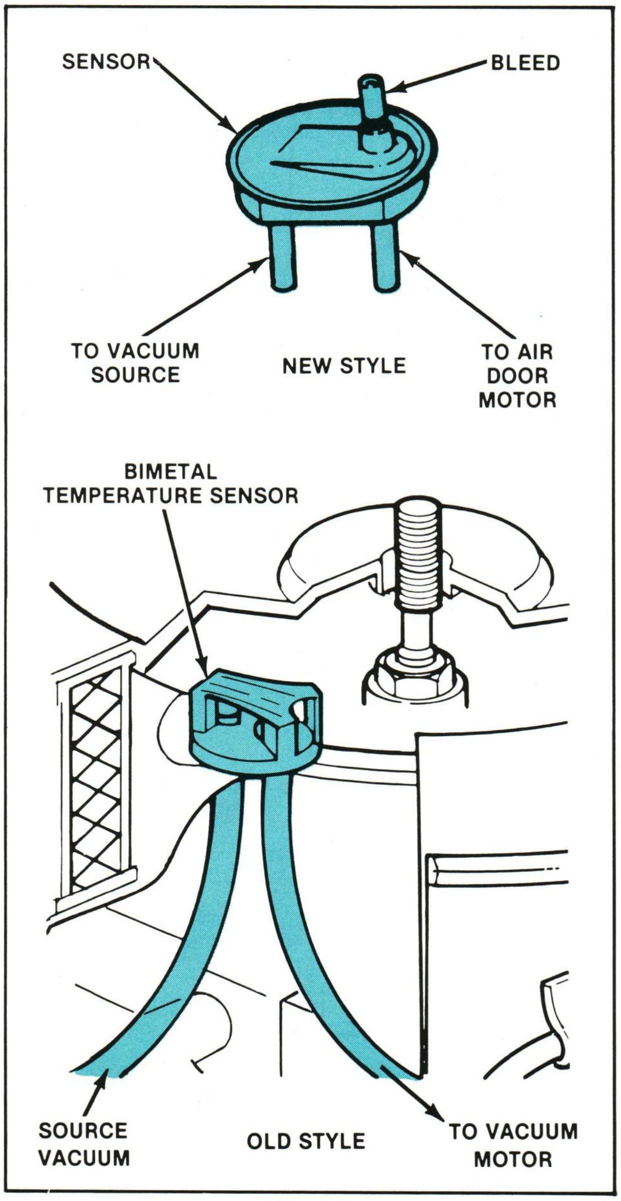


Figure 5. Temperature Sensor

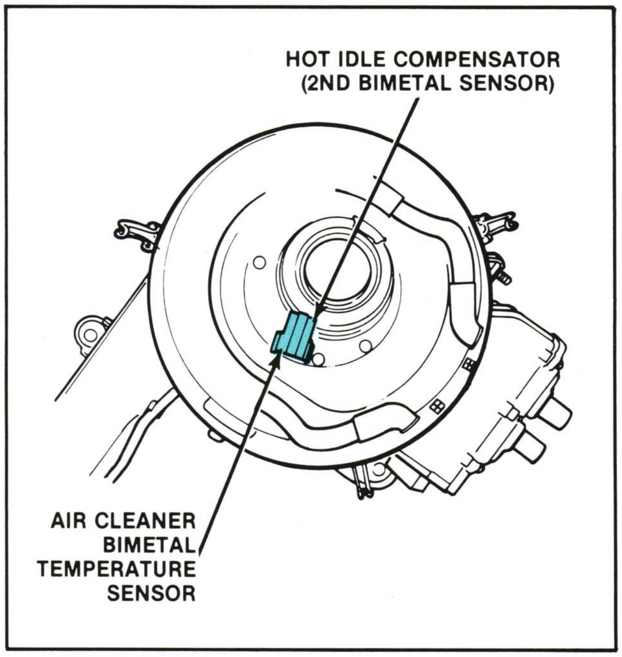

HOT IDLE COMPENSATOR (2ND BIMETAL SENSOR)
AIR CLEANER BIMETAL TEMPERATURE SENSOR

Figure 6. Twin Bimetal Sensor Application (1988 Festiva Shown)

Cold Weather Modulator

This device (Fig. 7) is a TVS (Temperature Vacuum Switch). It is used to hold vacuum on the vacuum motor in the event there is a sudden drop in manifold vacuum due to throttle opening. The Cold Weather Modulator functions only when the engine is cold.

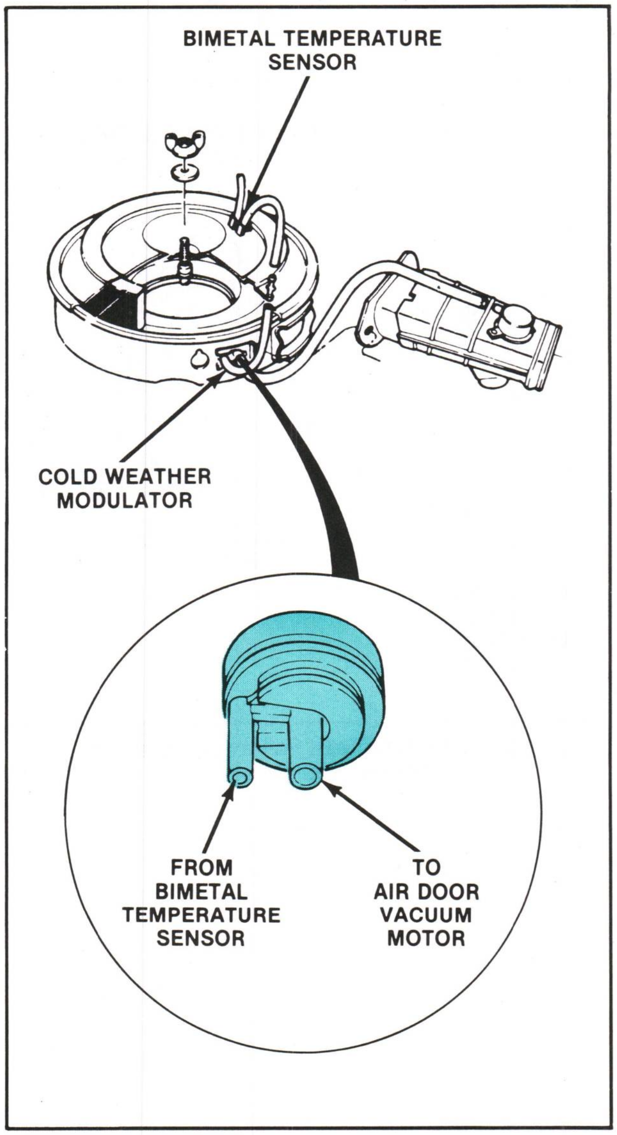


Figure 7. Cold Weather Modulator

In some instances the Cold Weather Modulator is replaced by a Retard Delay Valve (Fig. 8). The function of this component is the same as that of the Cold Weather Modulator in that it traps vacuum for a few seconds after the throttle is opened. Note that the retard delay valve is mounted in the vacuum line to the vacuum motor, not on the air cleaner like the cold weather modulator.

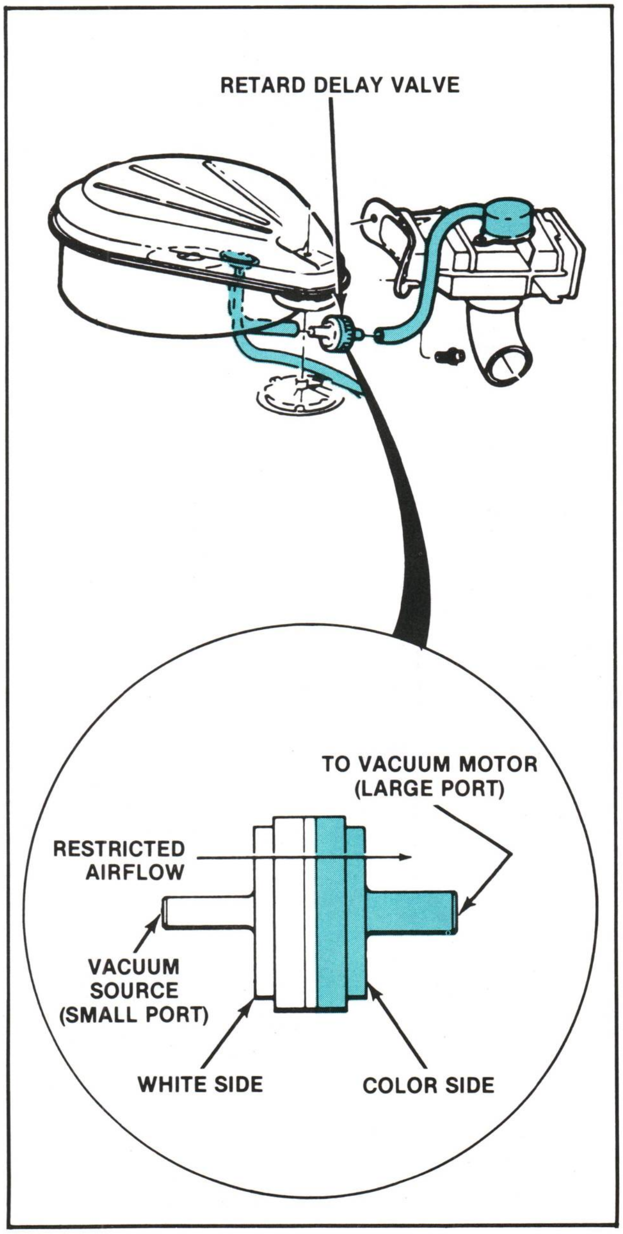


Figure 8. Retard Delay Valve

Vacuum Motor

The vacuum motor is normally mounted on the air cleaner snorkel (Fig. 9). Its purpose is to operate a door on the inside of the air cleaner to channel warm air that has passed over the manifold heat stove into the air cleaner, cold ambient air, or a mixture of the two. Note that in some instances there is a remote mounting of the vacuum motor (Fig. 10).

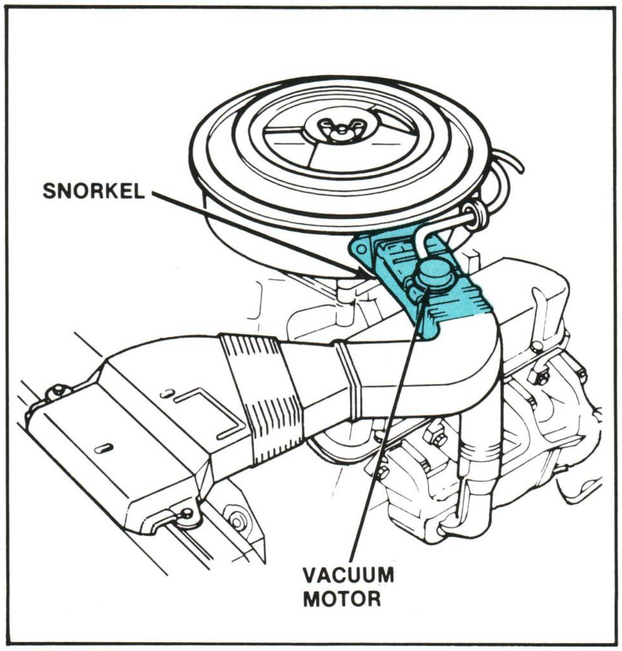


Figure 9. Vacuum Motor

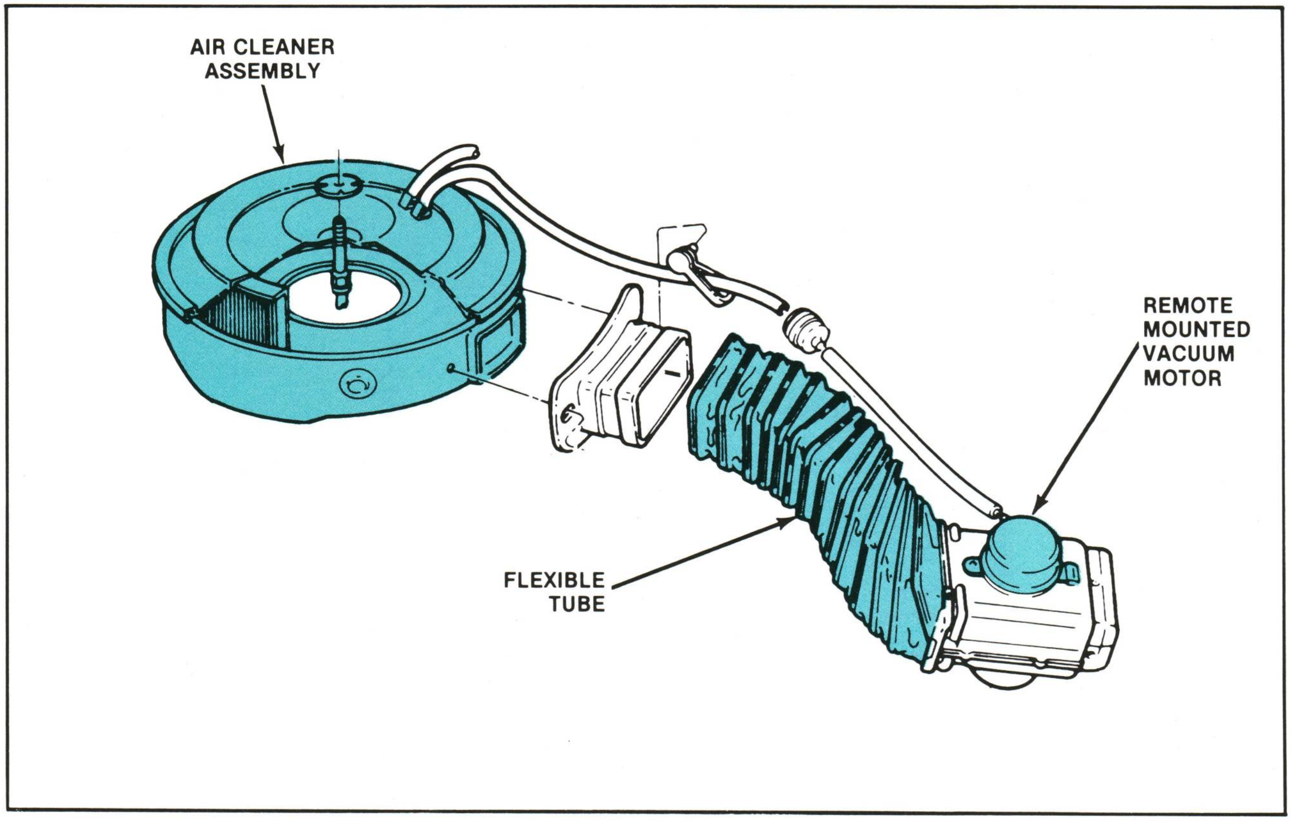


Figure 10. Remote-Mounted Vacuum Motor

Hot Air Tube And Heat Stove

The hot air tube (Fig. 11) extends from the air cleaner to the exhaust manifold heat stove. It is made of a special reinforced paper that is capable of withstanding high engine temperatures and a severe environment. In past years, the hot air tube was made of stamped steel. The purpose of the hot air tube is to conduct hot air from the manifold heat stove to the air cleaner during cold engine or cold ambient operation. It is important to keep a close eye on this tube when inspecting the engine compartment as it may deteriorate and start to leak, or could become disconnected from the heat stove or air cleaner. If the integrity of the hot air tube is disturbed (either through age or damage) then the heated air inlet system will not function to its full potential and driveability problems may result.

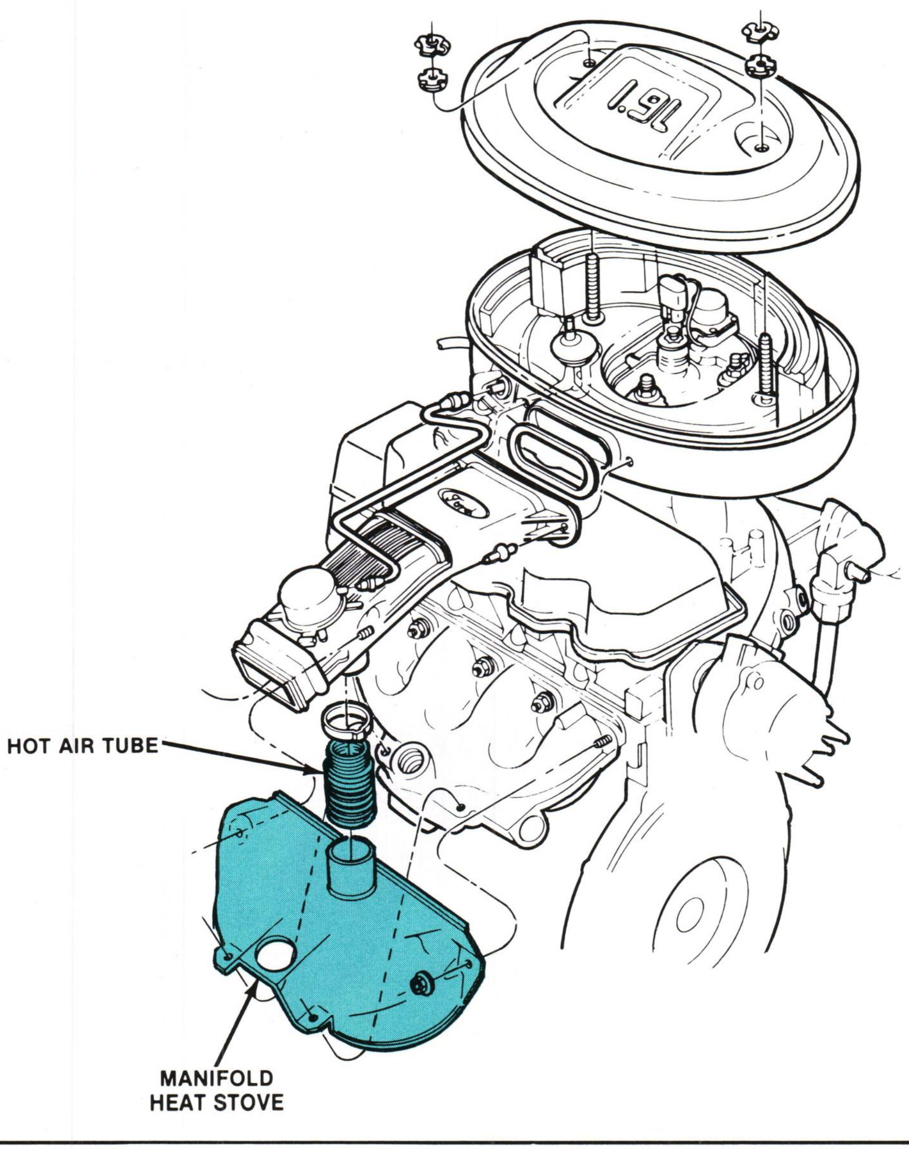
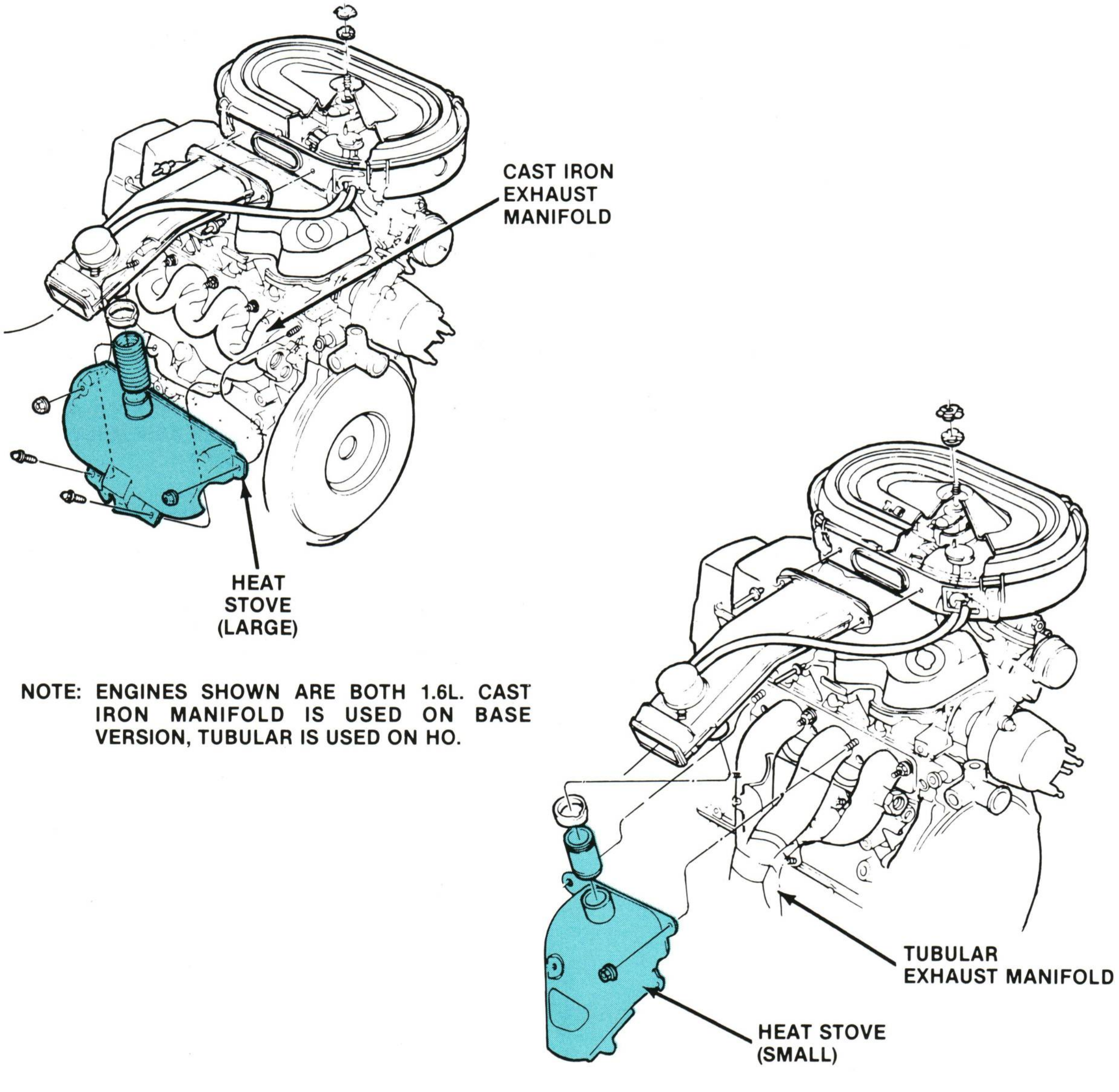


Figure 11. Hot Air Tube

The manifold heat stove (Fig. 12) is a sheet metal cover over one of the exhaust manifolds. During cold engine or cold ambient conditions, air is drawn over the exhaust manifold to heat it prior to entering the carburetor. Different size heat stoves are used depending on the application. Note that heat stoves used with tubular exhaust manifolds are much smaller than those used with cast iron manifolds. The reason for this is because tubular manifolds heat up at a much faster rate than their cast iron counterparts. Because of the rapid heating characteristics of the tubular manifold, the heat stove does not have to be as large.

That completes our brief review of the air cleaner assembly and the components that make it up. In the upcoming sections we will examine how these components combine to make the Heated Air Inlet System.



NOTE: ENGINES SHOWN ARE BOTH 1.6L. CAST IRON MANIFOLD IS USED ON BASE VERSION, TUBULAR IS USED ON HO.

Figure 12. Manifold Heat Stoves

NONHEATED AIR INLET SYSTEMS

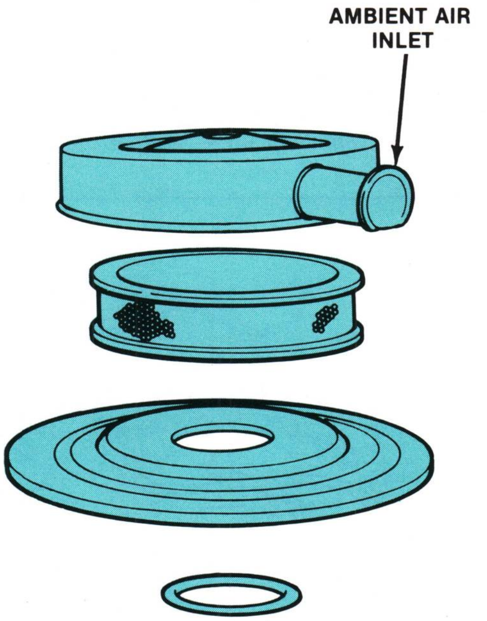
To understand the evolution of the Heated Air Inlet System we should first look at why it was introduced. The primary reason for its introduction was to allow a leaner air-fuel mixture to be used for:

- Cleaner Emissions
- Improved Cold Engine and Cold Weather Performance

We already know that an engine needs a clean unrestricted supply of fresh air so that it can properly operate. Early filter assemblies fulfilled this need, but could not properly contribute to improved engine performance, especially during cold engine operation.

These early systems (Fig. 13) only filtered the air entering the engine and did not serve any other purpose. Cold engine operation on these vehicles was not very good as performance and driveability suffered until the engine was sufficiently warmed up. To combat poor engine performance and driveability, it was found that the introduction of warm air into the engine would provide substantial improvement.

That is when the heated air inlet system was engineered to improve cold engine performance and driveability. With the introduction of this system, drivers did not have to warm up the engine for extended periods of time prior to driving to get proper performance and driveability characteristics.



NOTE: THERE IS NOWHERE FOR HEATED AIR TO ENTER THE AIR CLEANER ASSEMBLY.

Figure 13. Nonheated Air Inlet System

EVOLUTION OF ENGINE AIR INLET SYSTEMS

HEATED AIR INLET SYSTEMS

Heated Air Inlet Systems came into use during the sixties. These early systems did not differ drastically from those currently in use. Essentially they can be divided into two separate sections:

- Pre-Zip Tube System (Fig. 14)
- Zip Tube System (Fig. 15)

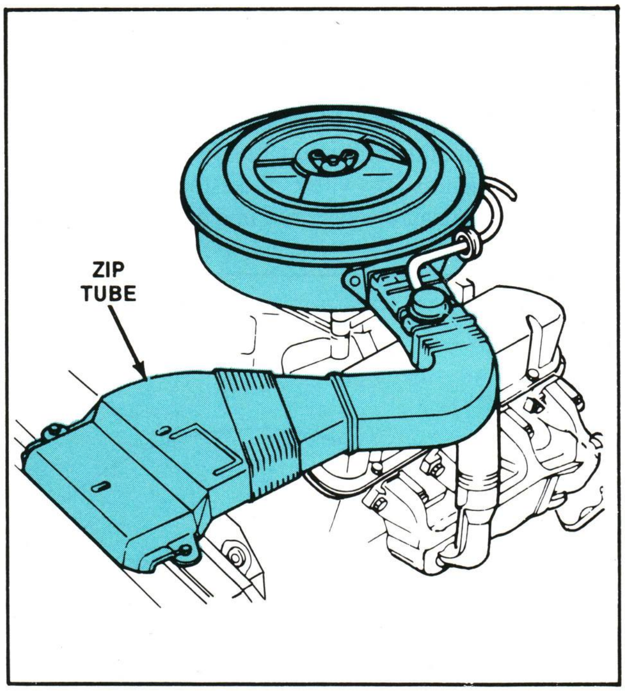


Figure 15. Zip Tube System

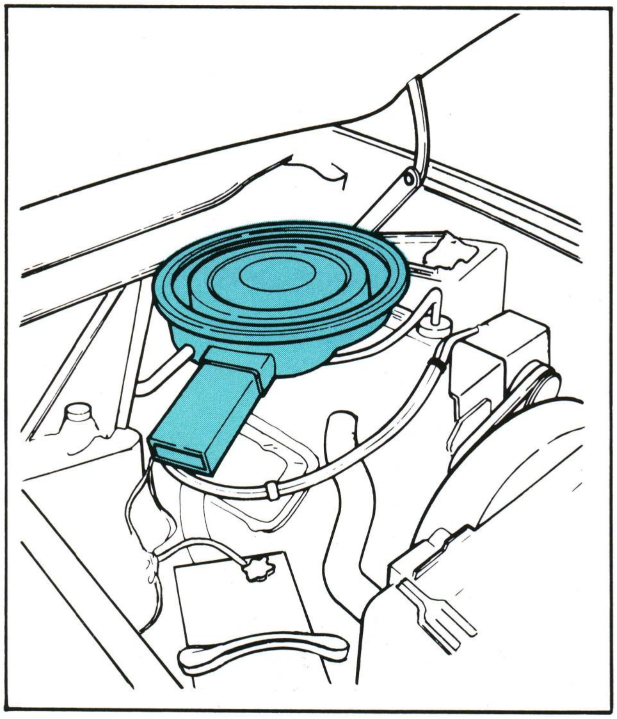


Figure 14. Pre-Zip Tube System

The zip tube is another name for the fresh air duct. You may run into the term ''zip tube'' in the Shop Manual or other publications, now you know what it is. The Pre-Zip Tube System essentially means that the system had no fresh air duct (Fig. 16). While those that are equipped with a fresh air duct are called Zip Tube Systems. With a zip tube the vacuum motor and inlet for warm air could be mounted almost anywhere under the hood. With a zip tube, remote air cleaners became possible.

The primary purpose of the zip tube is to provide cool outside air for better combustion. Air brought in from an outside source rather than from under the hood tends to be cooler and more dense (higher oxygen content). A denser air charge going into the engine provides improved combustion for better engine performance.

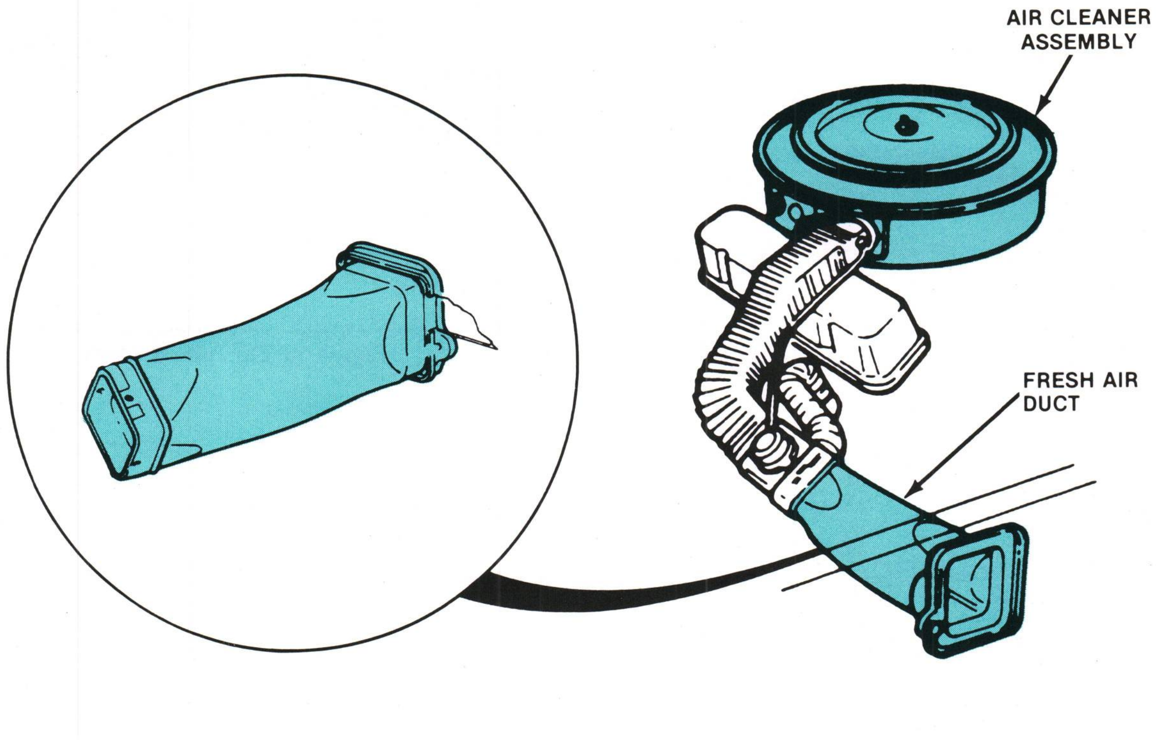


Figure 16. Fresh Air Duct

The installation of the zip tube posed a problem that should be mentioned—snow packing. During heavy snow situations, snow would be drawn into the zip tube and could actually clog the air inlet. This has been remedied by placing the air intake into an area where snow and other obstructions cannot get in, such as in the fenderwell (Fig. 17). Other applications use a shield in front of the air inlet (Fig. 18). This shield forces air entering the air intake to make a sharp turn. Normally snow and other potential obstructions cannot make the sharp turn, so they won't enter.

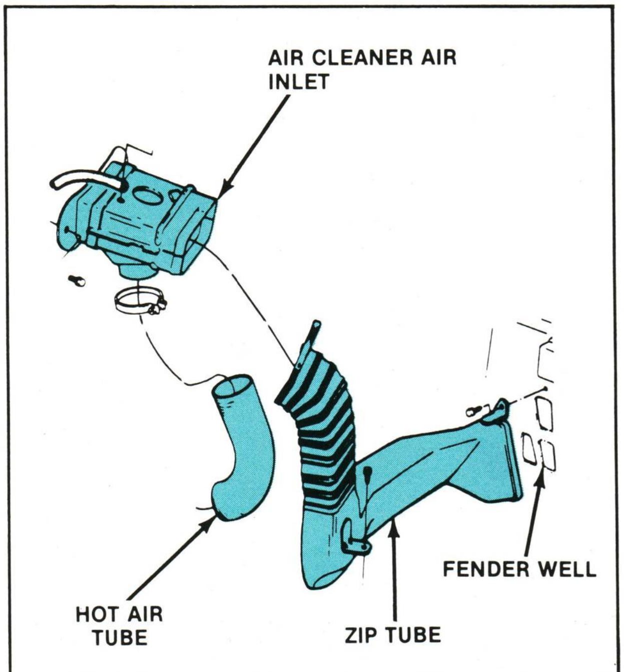


Figure 17. Fenderwell Air Intake

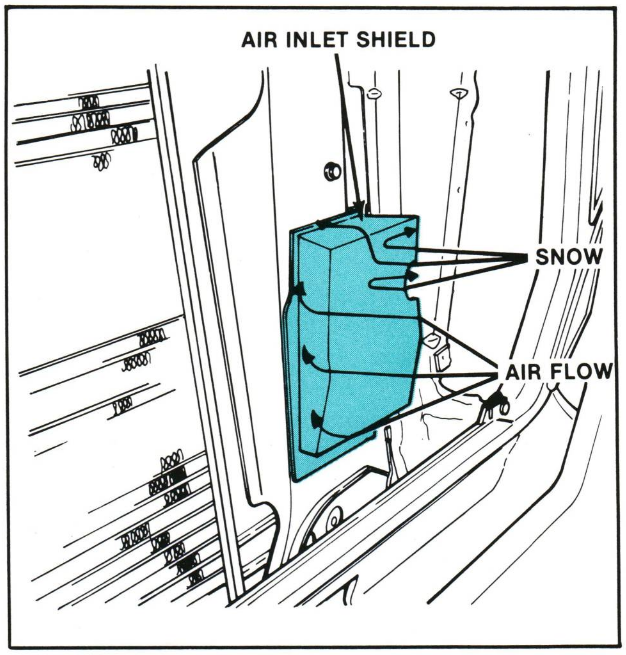


Figure 18. Air Intake Shield

Another method of differentiating the systems is by the device used to open and close the air cleaner assembly door. Two devices are used. Most common is the vacuum motor (Fig. 19) which was shown previously. This device simply uses manifold vacuum during periods of cold engine operation to hold the door closed, preventing ambient air from entering the air cleaner. All that is allowed in is warm air that has passed over the exhaust manifold. When the engine is shut off and there is no manifold vacuum, the air door is open to ambient air.

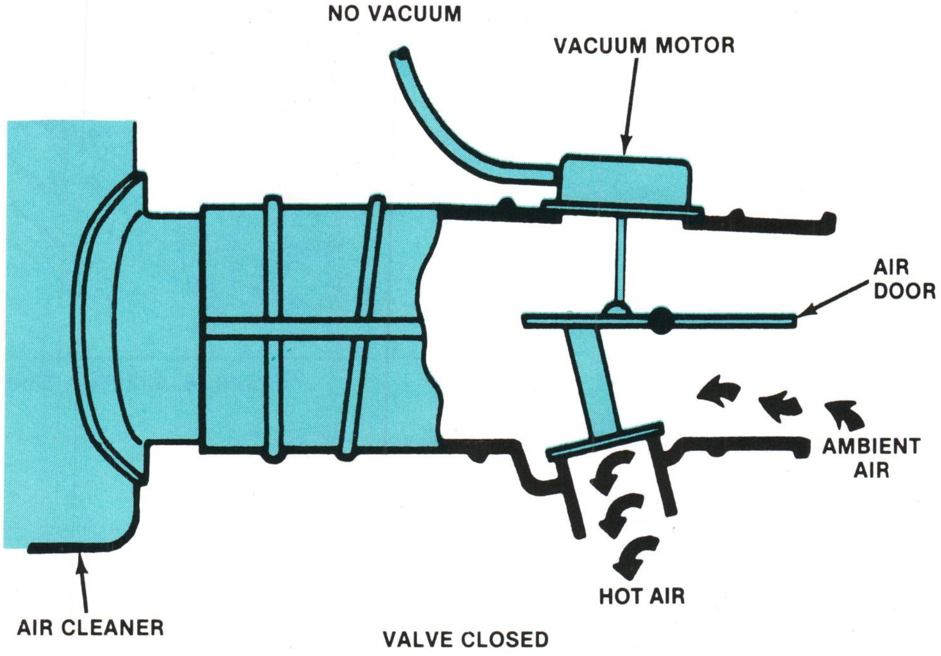


Figure 19. Vacuum-Controlled Door

The second type of device is a thermostatic element (Fig. 20). This device uses the power of a thermostatic element and spring pressure to open and close the air cleaner door. When the element is cold, the element is contracted, pulling the door closed and allowing only warm air into the air cleaner. As it warms up, the element expands and forces the door to close off the opening to the exhaust manifold heat stove, allowing ambient air to enter the system. When the engine is shut off (and cold), the thermostatic element naturally closes the opening to the ambient air, which is the opposite of what occurs with the vacuum operated door.

The thermostatic element type of air door control was last used in the late 1970s. Since then, the vacuum-controlled unit has been in common use.

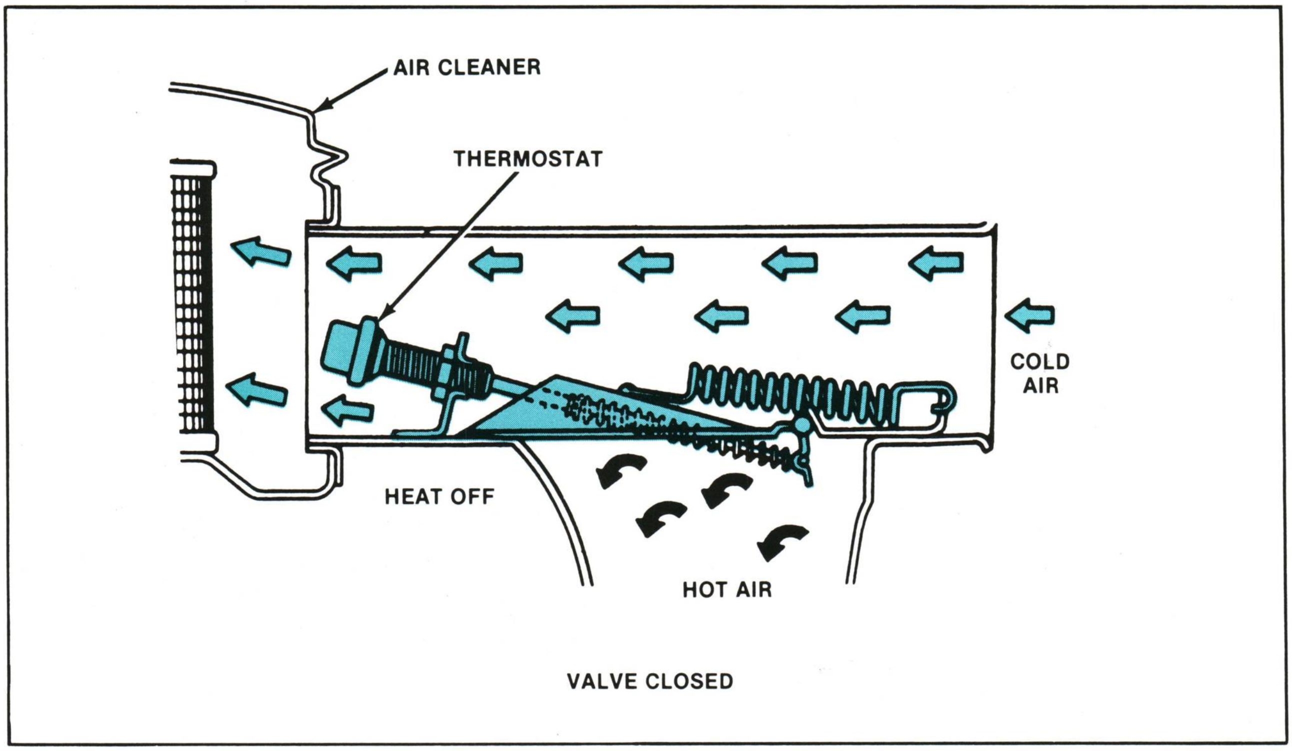


Figure 20. Thermostatically Controlled Door

SYSTEM OPERATION

When the engine is cold, air is drawn through a heat stove mounted over the exhaust manifold. The heat stove is essentially a sheet metal cover over the manifold, which traps the air warmed by the manifold (Fig. 21). The warm air is drawn from the area over the manifold to the air cleaner through the hot air tube.

Admittance of the warm air to the air cleaner is through a duct valve built into the air cleaner snorkel (Fig. 22). The duct valve is attached to the air door. When the engine is cold, vacuum is applied to the vacuum motor which holds the door up, allowing warm air to get past the duct valve. With the air door held in this position, ambient air is blocked from entering the air cleaner assembly. Only air warmed by the exhaust manifold heat stove is admitted.

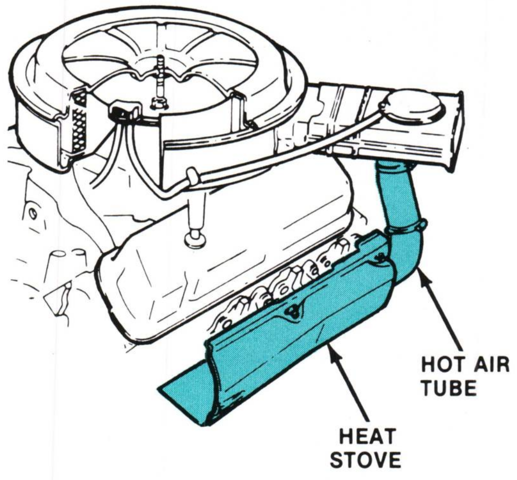


Figure 21. Heat Stove

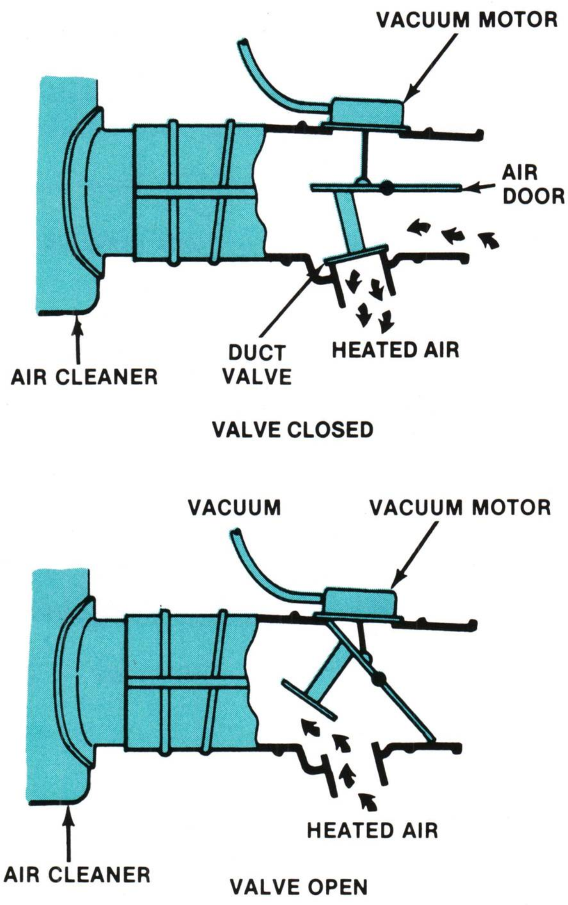


Figure 22. Duct Valve

The opening and closing of the door is controlled by a bimetal sensor (Fig. 23). It is installed in the air cleaner body (or in remote air cleaner applications, the air horn assembly) so that it senses the air cleaner temperature. Depending on the calibration, the sensor can be set to operate at temperatures that range between 75 °F to 105 °F or even higher if needed. It is the bimetal sensor that actually controls the operation of the door by controlling vacuum going to the vacuum motor.

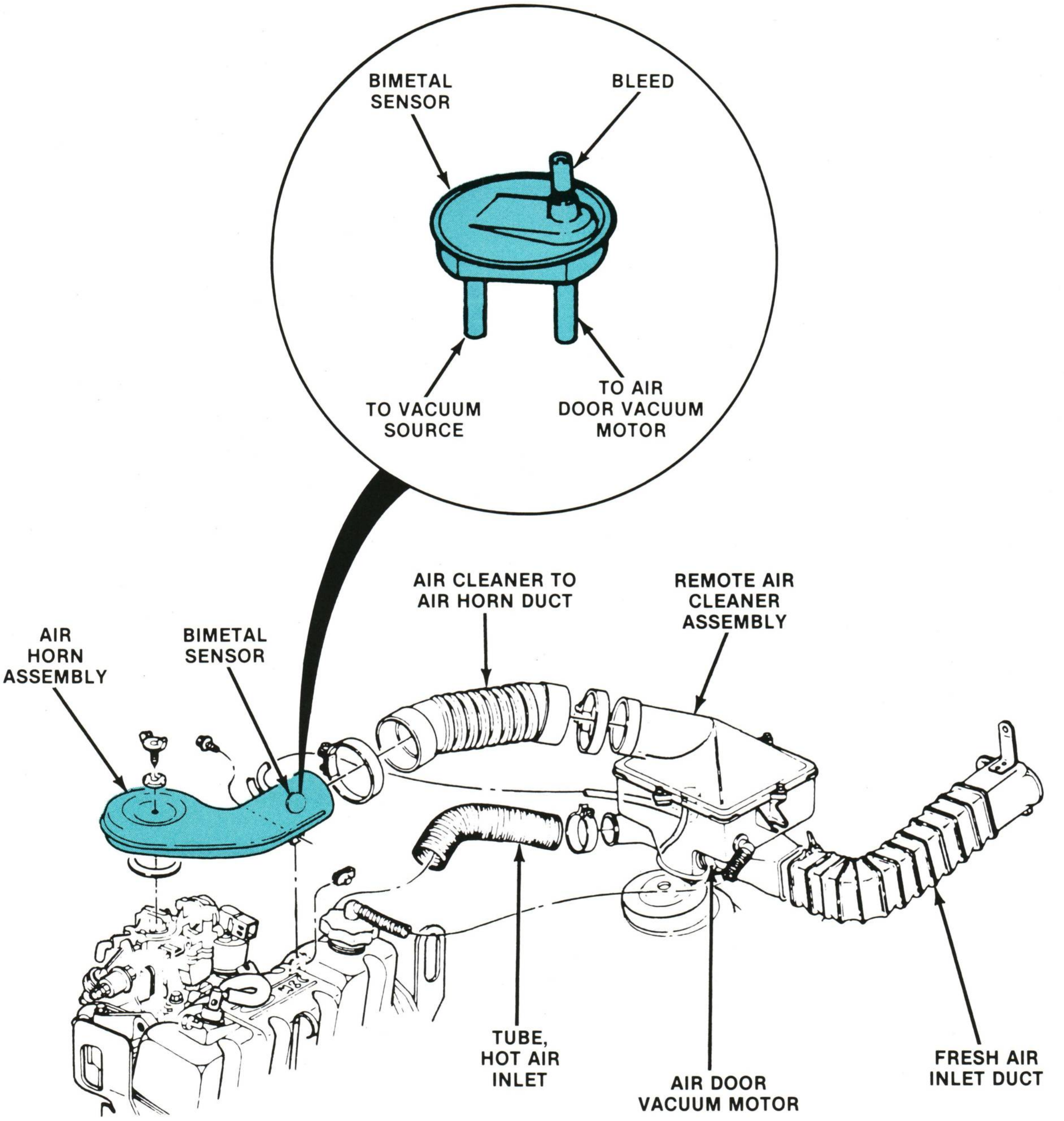


Figure 23. Bimetal Sensor

Operating Sequence

The actual function of the air inlet system is provided in the following descriptions. Once you've learned what happens in the heated air inlet system during its operating modes, we'll look at how the system is precisely controlled to provide optimum performance.

Cold Start-Up

During this mode of operation (Fig. 24), the bimetal sensor has closed off the vacuum bleed completely. Also, with the engine at fast idle, there is strong manifold vacuum. This combination of strong manifold vacuum and no vacuum bleed cause the vacuum motor to pull the air cleaner door completely closed, closing off ambient air. With the opening to ambient air completely closed, only heated air from the exhaust manifold heat stove is allowed into the air cleaner.

COLD OPERATION
- Sensor temperature is colder than bleed temperature
- Full vacuum to vacuum motor

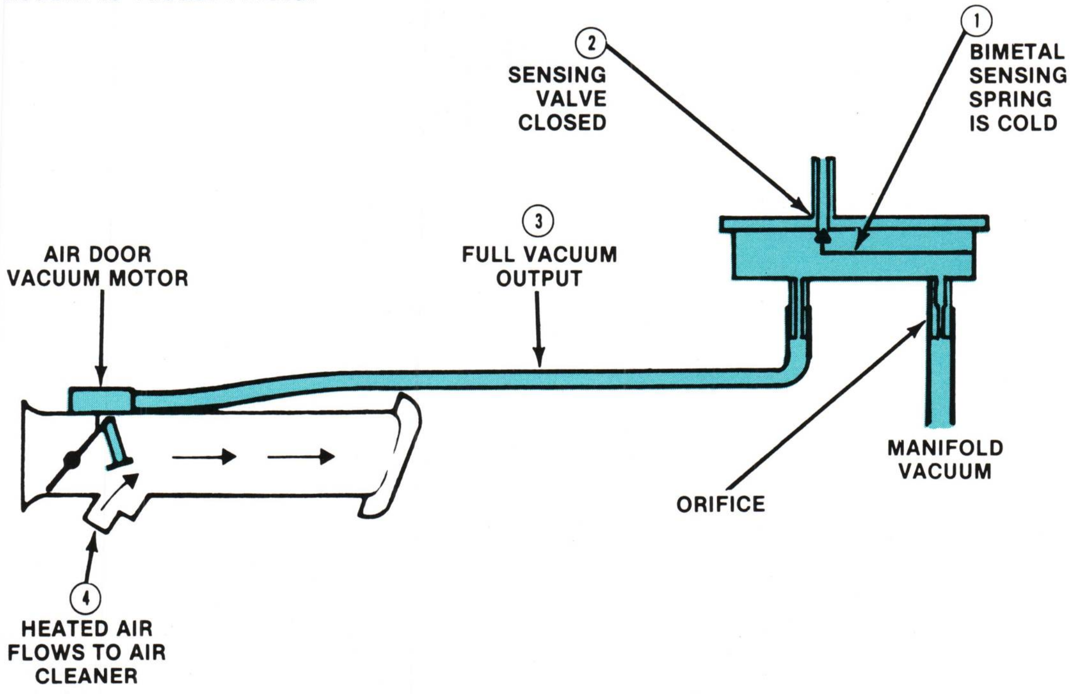


Figure 24. Cold Start-Up

Modulating Partial Warm-Up

During this mode of operation (Fig. 25), the air cleaner temperature is beginning to warm. At idle and part throttle, the engine is producing moderate to strong vacuum so that there is plenty of vacuum to keep the air cleaner door shut. At this point though, the bimetal sensor is beginning to warm and opens the vacuum bleed. This allows the door to close and reduce the amount of heated air. With the door closing off the heated air inlet from the manifold heat stove, ambient air is allowed into the air cleaner. The rate of door opening and closing is directly proportional to the air temperature within the air cleaner assembly as determined by the bimetal sensor.

Note that as ambient temperature goes up, the cycle time decreases and the air cleaner bimetal keeps the air door open continually to ambient air. As ambient temperature goes down, cycle time increases as the air cleaner bimetal sensor opens and closes the air door between ambient and heated air.

NOTE: Contrary to popular belief, the air cleaner door does not modulate to a partially open or partially closed position to vary the amount of mixing between heated and ambient air. It simply opens and closes in relation to vacuum being applied or released.

The requirements determined by the bimetal sensor will close or open the warm air duct as needed.

AIR CLEANER BIMETAL SENSOR OPERATION

BLEED (MODULATING OPERATION)

- Air cleaner is warm but not up to temperature setting
- Part of the source vacuum is bled off
- Modulating time is very brief
- Sensor is much like ON/OFF switch

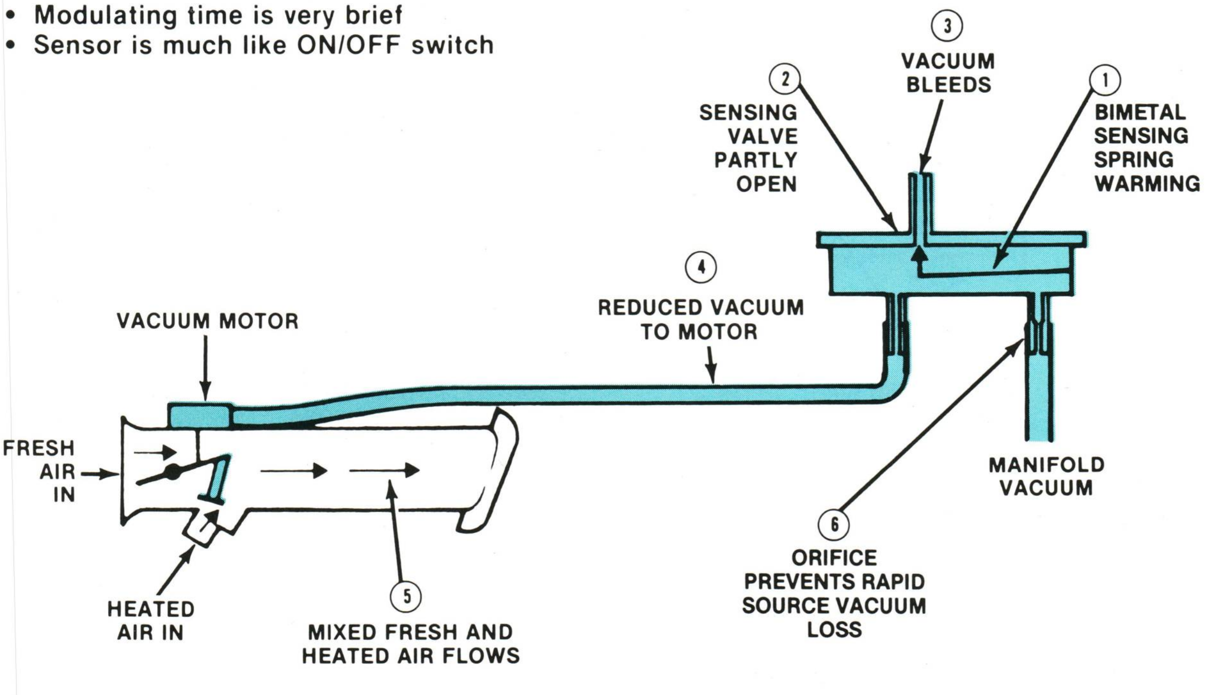

③
VACUUM BLEEDS
②
SENSING VALVE PARTLY OPEN
①
BIMETAL SENSING SPRING WARMING
④
REDUCED VACUUM TO MOTOR
VACUUM MOTOR
FRESH AIR IN
MANIFOLD VACUUM
⑥
ORIFICE PREVENTS RAPID SOURCE VACUUM LOSS
HEATED AIR IN
⑤
MIXED FRESH AND HEATED AIR FLOWS

Figure 25. Modulating Partial Warm-up

Hot Engine/Hot Ambient Air

In this mode of operation (Fig 26), the temperature within the air cleaner has warmed considerably. At this point there is sufficient vacuum to close the air door, but the bimetal temperature sensor has reached a point where it is bleeding off all vacuum used to apply the door. Because of the total bleed off of vacuum, the air door is able to open to allow a full charge of ambient air into the engine. None of the air coming into the air cleaner is heated.

HOT AMBIENT AIR/HOT AIR CLEANER
- Above temperature setting
- All source vacuum is bled off

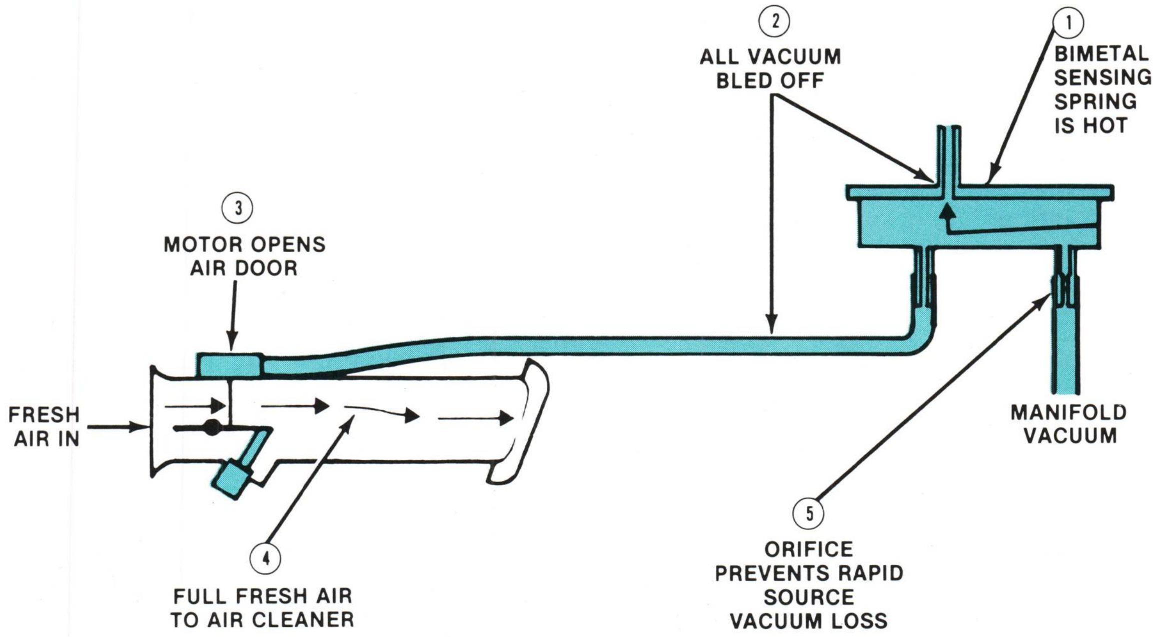

②
ALL VACUUM BLED OFF
①
BIMETAL SENSING SPRING IS HOT
③
MOTOR OPENS AIR DOOR
FRESH AIR IN
MANIFOLD VACUUM
⑤
ORIFICE PREVENTS RAPID SOURCE VACUUM LOSS
④
FULL FRESH AIR TO AIR CLEANER

Figure 26. Hot Engine/Hot Ambient Air Operating Mode

SYSTEM CONTROLS

Now that you've seen the operation of the system, and have an understanding of the components that make it up, let's take a look at the specific system controls and how they function within the system operating parameters. The devices that are considered control devices in the system are the:

- Bimetal Sensor
- Air Cleaner Door Vacuum Motor
- Cold Weather Modulator and Retard Delay Valve

Bimetal Sensor

The bimetal sensor, as we've already described, opens and closes the vacuum bleed of the vacuum motor in accordance with the temperature of the air entering the engine. Let's look at the operating modes of the bimetal sensor (Fig. 27).

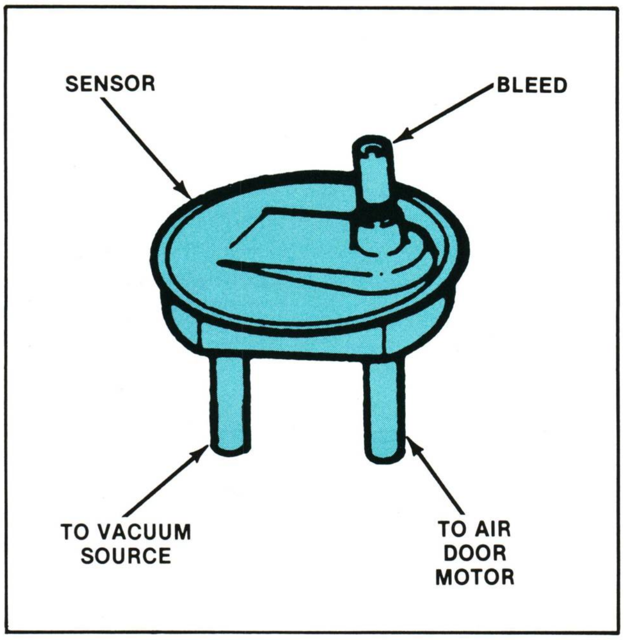


Figure 27. Air Cleaner Bimetal Sensor

When the bimetal sensor is cold it has closed off its vaccum bleed totally (Fig. 28). At this point it conducts full vacuum to the vacuum motor. As it warms up, the bimetal sensor begins to bleed manifold vacuum so that a reduced amount is allowed to go to the vacuum motor. Once it reaches its full open temperature, all available vacuum is bled off and no vacuum reaches the vacuum motor.

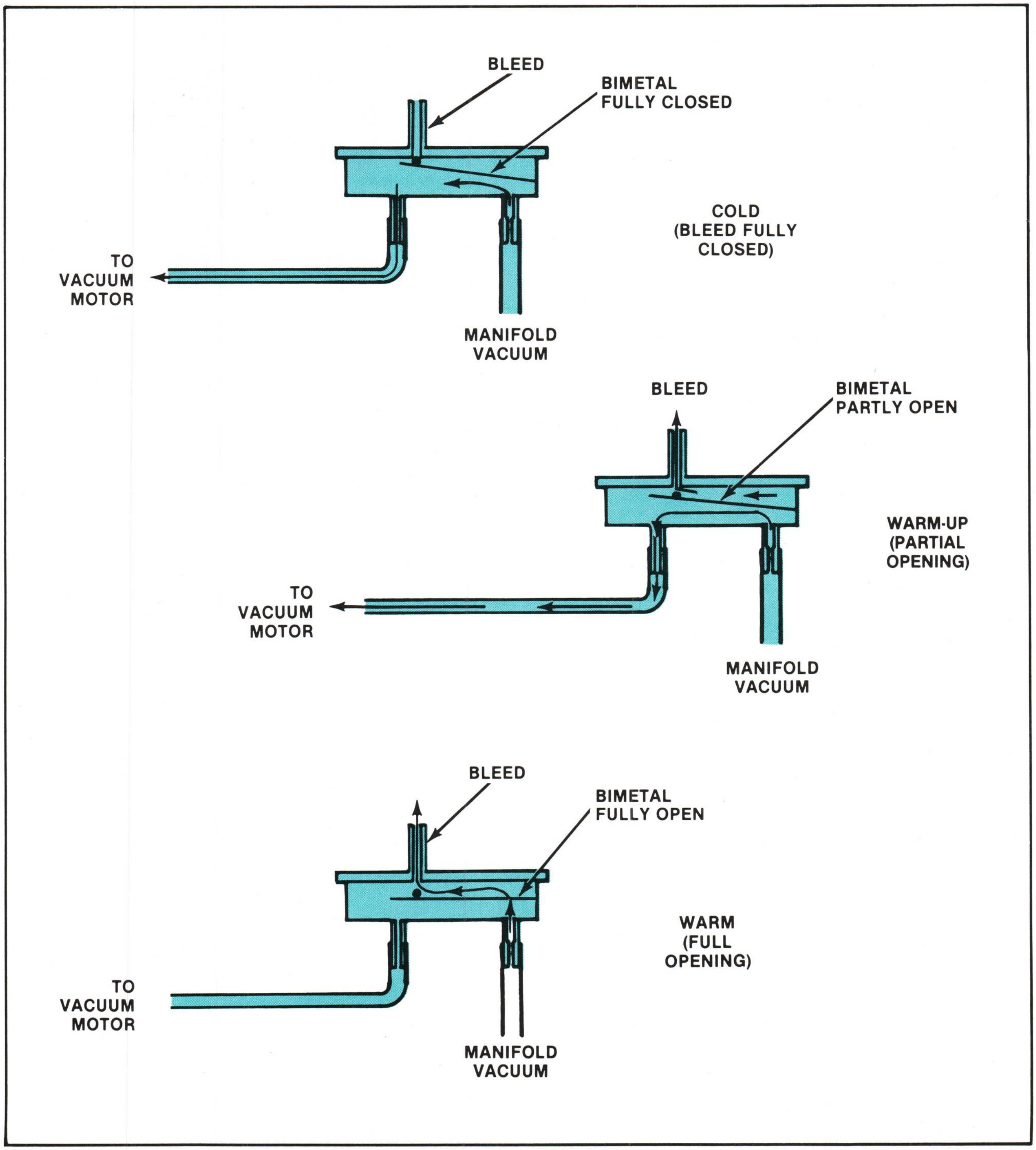


Figure 28. Bimetal Sensor Operating Modes

There are several bimetal sensors available that have different temperature settings so that they can be applied to different engine calibrations. These bimetal sensors are color-coded so that they can be easily identified. The following chart (Fig. 29) shows several different bimetal sensors that are currently in use. Note their different temperature settings.

NOTE: There are several temperature settings available. The sensor is calibrated to provide a specific output vacuum to the air door motor as it warms to its temperature setting. The calibration is based on 16 in. Hg. of source vacuum.

COLOR CODE	TEMP. SETTING	VACUUM OUTPUT WITH 16 IN. HG. AT SOURCE	BLEED SETTING	VACUUM OUTPUT WITH 16 IN. HG. SOURCE
BROWN	75° F	1-5 IN. HG.	40° F	11 IN. HG
PURPLE, BLACK	90° F		55° F	
GREEN, YELLOW	105° F		70° F	
PINK	90° F	4-9 IN. HG.	65° F	
BLUE	105° F		80° F	

Figure 29. Bimetal Sensors By Color Coding

Air Cleaner Door Vacuum Motor

The vacuum motor (Fig. 30) essentially closes off heated air or fresh ambient air upon receiving vacuum signals from the air cleaner bimetal sensor. It would seem that the vacuum motor would modulate between its open and closed positions, blending the heated air and ambient air. This is really not the case. The air cleaner door vacuum motor is really an on or off device. If vacuum is applied, heated air enters the air cleaner. If vacuum is removed, ambient air is admitted. There is very little fluctuation between the open and closed positions, the vacuum motor is not a highly sophisticated device. Vacuum motors do differ between models, engines, and applications. The primary difference between them is the vacuum pressure that must be applied to move the door.

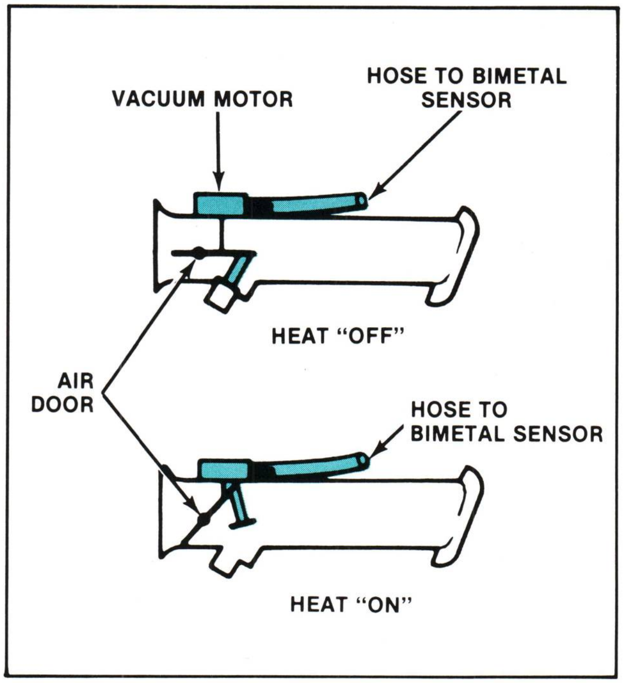


Figure 30. Air Cleaner Vacuum Motor

Cold Weater Modulator Function

At times it is desirable to keep the air cleaner door in a position that allows heated air into the air cleaner, even when vacuum drops sufficiently to release the door and allow ambient air in. This type of situation would occur in cold weather, when the engine is not sufficiently warmed up. As we stated earlier, the Cold Weather Modulator is placed into the system to prevent the air door from suddenly opening in the event of a drop in vacuum when the engine is cold, and there is a cold ambient temperature.

NOTE: The cause of a rapid drop in vacuum would occur with the engine operating at or near W.O.T. (Wide Open Throttle).

Placement of the cold weather modulator is between the vacuum motor and the bimetal sensor (Fig. 31). With the cold weather modulator in this position, it is able to hold vacuum on the vacuum motor when vacuum drops.

Note that the cold weather modulator is a vacuum trap and must be properly placed in the system to function as intended. The large (center) port goes to the vacuum motor. The small port (off center) goes to the source.

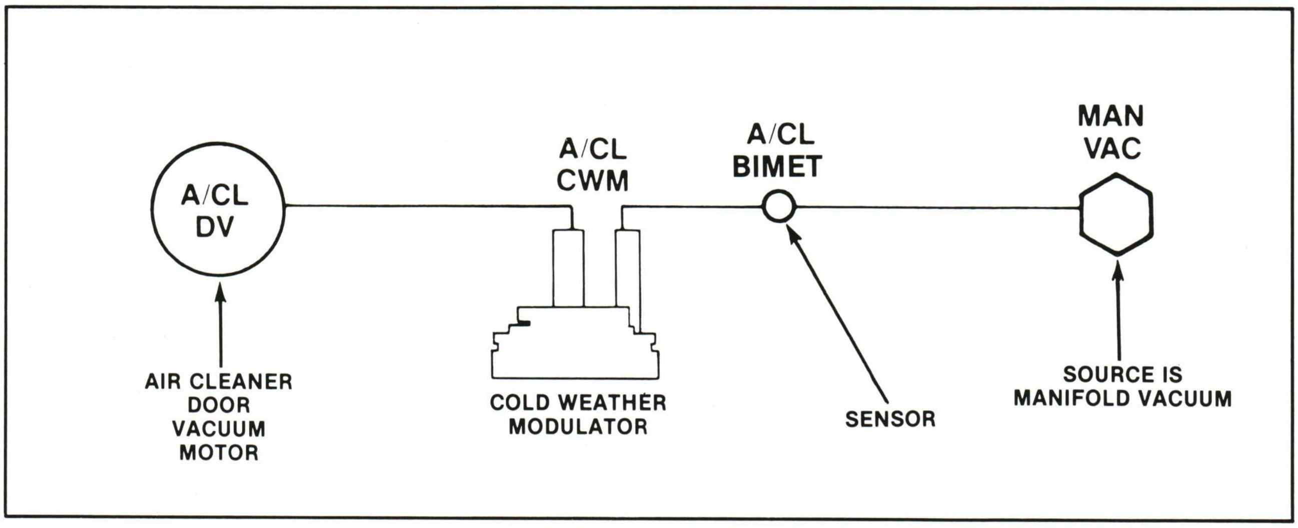
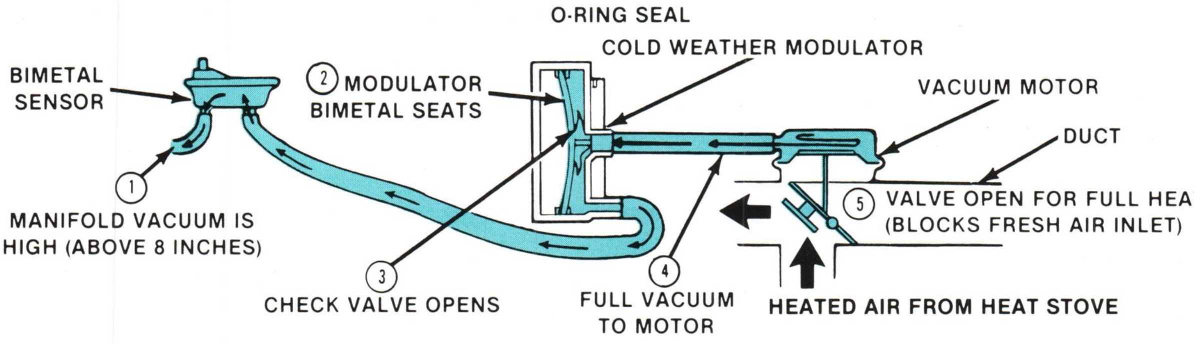


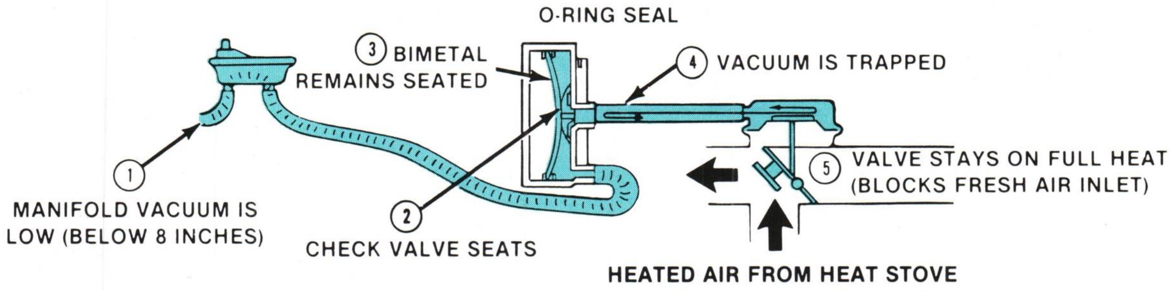
Figure 31. Cold Weather Modulator Schematic

The cold weather modulator operates in the following manner (Fig. 32): A bimetal sensor within the cold weather modulator is sensitive to air cleaner temperature. During cold weather operation, the bimetal sensor is in its seated position against the check valve on the interior of the cold weather modulator. Vacuum holds this check valve open. During periods of heavy acceleration, when the bimetal sensor in the cold weather modulator is below its set temperature, the vacuum drops. The residual vacuum remaining in the line going to the vacuum motor pulls the check valve closed. The bimetal sensor, because it is in its seated position, closes off the bleed on the check valve. This assures that the vacuum motor continues to hold the door so that warm air from the heat stove is admitted to the engine.

COLD START OPERATION


O-RING SEAL
COLD WEATHER MODULATOR
BIMETAL SENSOR
② MODULATOR BIMETAL SEATS
VACUUM MOTOR
DUCT
① MANIFOLD VACUUM IS HIGH (ABOVE 8 INCHES)
⑤ VALVE OPEN FOR FULL HEAT (BLOCKS FRESH AIR INLET)
③ CHECK VALVE OPENS
④ FULL VACUUM TO MOTOR
HEATED AIR FROM HEAT STOVE

ACCELERATION (MODULATOR TEMPERATURE BELOW 55°F.)


O-RING SEAL
③ BIMETAL REMAINS SEATED
④ VACUUM IS TRAPPED
① MANIFOLD VACUUM IS LOW (BELOW 8 INCHES)
⑤ VALVE STAYS ON FULL HEAT (BLOCKS FRESH AIR INLET)
② CHECK VALVE SEATS
HEATED AIR FROM HEAT STOVE

WARM ENGINE (MODULATOR TEMPERATURE ABOVE 55°F.)

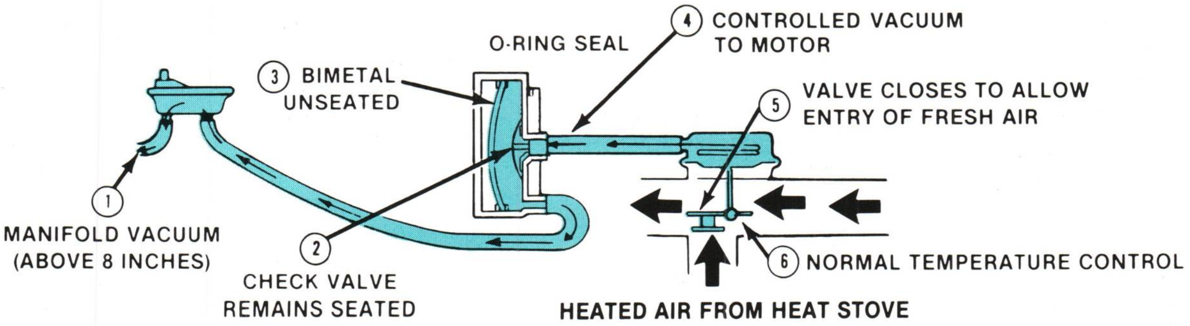

④ CONTROLLED VACUUM TO MOTOR
O-RING SEAL
③ BIMETAL UNSEATED
⑤ VALVE CLOSES TO ALLOW ENTRY OF FRESH AIR
① MANIFOLD VACUUM (ABOVE 8 INCHES)
② CHECK VALVE REMAINS SEATED
⑥ NORMAL TEMPERATURE CONTROL
HEATED AIR FROM HEAT STOVE

Figure 32. Cold Weather Modulator Operation

Once air temperature in the air cleaner is above the set temperature of the bimetal sensor in the cold weather modulator, the sensor moves into its unseated position. In this position, there is a direct passage through the check valve to the vacuum motor.

As you can see, the cold weather modulator will only hold vacuum on the motor during cold engine operation. Once the bimetal sensor unseats, the vacuum motor is subjected to any drop or rise in vacuum without any extra control.

NOTE: During cold operating conditions, above the seated position of the cold weather modulator bimetal sensor, it is advantageous for the vacuum motor to close off heated air from the heat stove during periods of low vacuum. This is because there is a substantial amount of restriction when air is drawn only from the exhaust manifold heat stove. By closing off this passage and opening the air cleaner door to fresh, ambient air, performance is substantially increased. This is why the cold weather modulator operates only during cold conditions—normally below 55 °F.

Retard Delay Valve Function

The retard delay valve performs the same function as the cold weather modulator, preventing low vacuum override of the air door. It has essentially the same positioning as the cold weather modulator, between the air cleaner bimetal temperature sensor and the vacuum motor for the air door (Fig. 33).

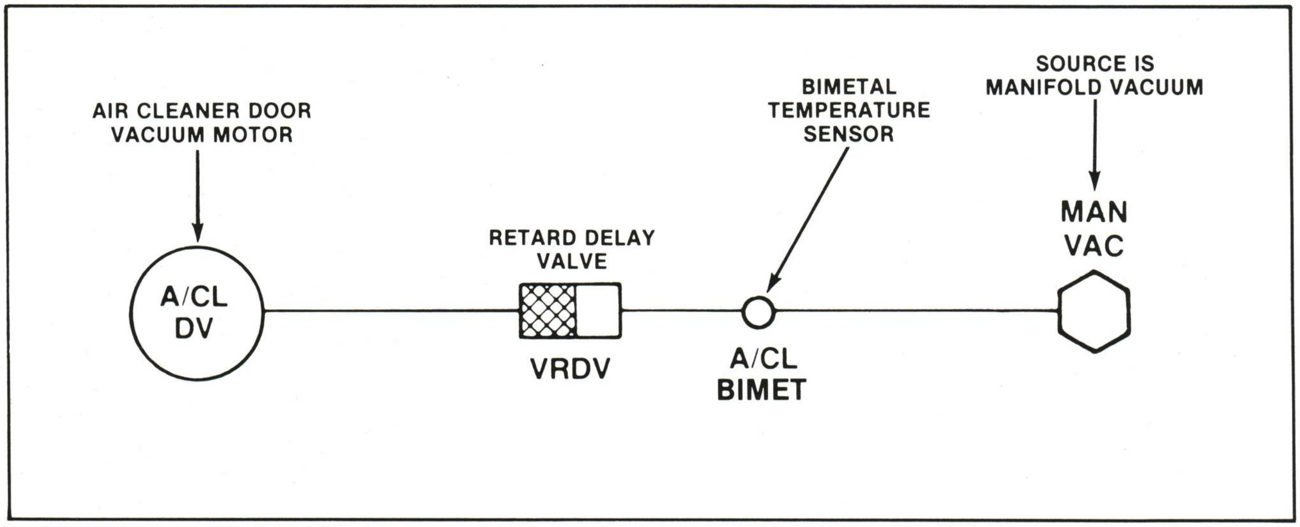

AIR CLEANER DOOR VACUUM MOTOR
A/CL DV
RETARD DELAY VALVE
VRDV
BIMETAL TEMPERATURE SENSOR
A/CL BIMET
SOURCE IS MANIFOLD VACUUM
MAN VAC

Figure 33. Retard Delay Valve Schematic

Unlike the cold weather modulator, the retard delay valve is not a temperature vacuum switch (TVS). It does not contain any type of temperature sensing device. This valve simply delays the release of vacuum from the vacuum motor when the vacuum suddenly drops off. It accomplishes this by an umbrella check valve mounted on a restrictor plate (Fig. 34). When there is a strong vacuum signal, the umbrella check valve is held open, allowing an unrestricted flow between the air cleaner bimetal temperature sensor and the vacuum motor. Once source vacuum drops, the residual vacuum in the vacuum motor pulls the valve closed, holding vacuum on the vacuum motor.

The residual vacuum on the vacuum motor is slowly bled off through sintered steel restrictor devices built into the restrictor plate. These allow air to be admitted slowly into the line between the retard delay valve and the vacuum motor. Once vacuum is sufficiently bled off, the vacuum motor air door is opened to allow fresh, ambient air to be admitted to the engine.

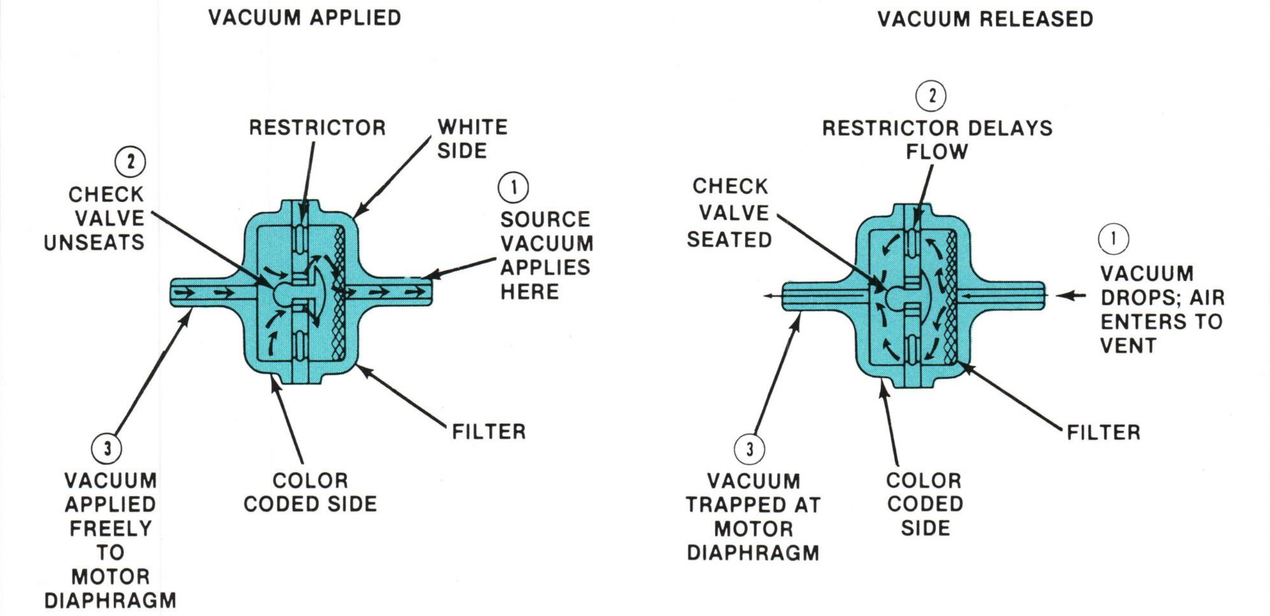


Figure 34. Retard Delay Valve Operation

The retard delay valve has the following characteristics:

- It prevents rapid oscillations of the vacuum motor air door. If the door were allowed to slam open and closed, it would quickly wear the door out.
- It prevents the door from blowing open during initial launch at wide open throttle (W.O.T.) or low vacuum acceleration. If the door were allowed to blow open, the rush of cold, ambient air may cause the engine to stumble. With the slower opening caused by the retard delay valve, the engine receives warm air initially, a mix of warm and ambient air as the door opens, then full ambient air once the door is completely open. This progression allows the engine a brief amount of time to get the rpms up and prevent any stumbling or hesitation.
- It increases the temperature fluctuations within the air cleaner. This is not a positive quality, but essentially causes no harm. Because the air door cannot open and close rapidly, the temperature within the air cleaner has larger fluctuations than it would normally have if the air door were allowed to slam open and closed quickly.

Essentially what the retard delay valve does is allow the engine to have warm air as needed, once the rpms are sufficiently high; the engine is able to handle the fresh, cold air. The engine receives warmed air only as long as the retard delay valve can hold vacuum on the vacuum motor. The amount of time the retard delay valve holds vacuum on the vacuum motor is determined during engine calibration at Ford Motor Company. There are different retard delay valves used for different engines and applications. These valves are color-coded for easy identification.

EARLY FUEL EVAPORATION (EFE) HEATER

The EFE heater is not part of the Heated Inlet Air System, but works in close conjunction with it to assure proper engine performance at cold ambient temperatures. The EFE heater is placed at the base of the carburetor (Fig. 35). It heats the incoming fuel/air mixture, evaporating the fuel to assure that there is complete mixing of the fuel and air.

NOTE: During cold engine operation, fuel tends to condense on cold cylinder walls, disrupting the smooth even flow of fuel into the engine. By heating the fuel-air mixture this tendency for the fuel to condense is reduced, allowing for better cold engine/cold weather performance.

The EFE heater is turned on and off by a relay that is activated in accordance with engine coolant temperature. The EFE heater is a self-regulating device that controls its own temperature. EFE heaters are a positive temperature coefficient (PTC) device. This type of device increases in electrical resistance as its temperature rises. As the temperature rises, the passage of electrical current is reduced, thereby maintaining the EFE heater at a set temperature.

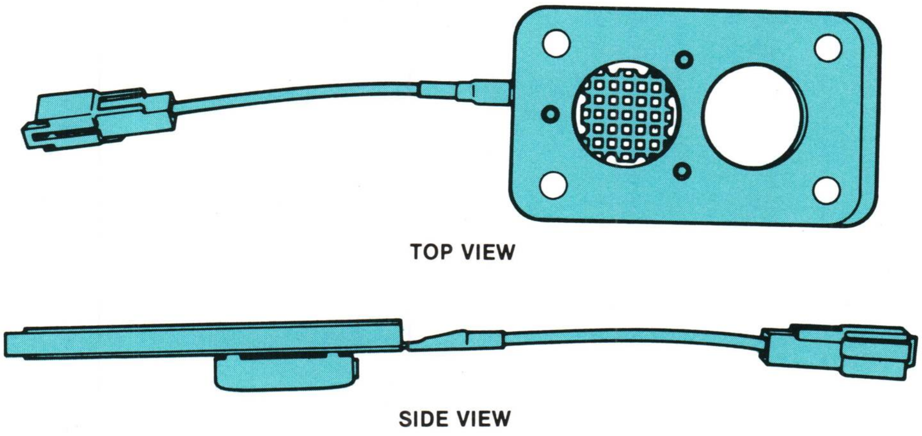


Figure 35. EFE Heater

CURRENT HEATED AIR INLET SYSTEMS

Currently heated air inlet systems are used primarily on vehicles equipped with CFI (Central Fuel Injection) or carburetors. The majority of the heated air inlet systems in use operate in a fashion similar to those described earlier in this manual. All systems as of the 1988 model year are the bimetal-controlled—vacuum motor type. These systems operate using the vacuum apply—vacuum bleed principle at the air cleaner bimetal sensor that was described in the previous section. There are no electronic controls on this system.

IMPROVEMENTS OVER EARLY SYSTEMS

The major area of improvement in the heated air inlet system has been in making the heated air inlet system react rapidly to temperature changes. The reaction to temperature changes obviously involves the bimetal temperature sensor. Improvements have been made to make the metals more sensitive to temperature changes so that the vacuum to the motor controlling the air door can be bled off or applied depending upon the temperature conditions.

The amount of lag time between the proper air temperatures being met and the air door opening can be seen on this chart (Fig. 36). Conversely, you can also see the amount of lag time that is evident for the closing of the air bleed by the bimetal sensor should temperatures drop below the set temperature. Also, keep in mind that the retard delay valve (if used) increases the amount of lag time.

NOTE: The chart shown in Figure 36 shows reaction time comparison between a conventional system and the electronically controlled Inlet Air System (I.A.S.) which we will cover next.

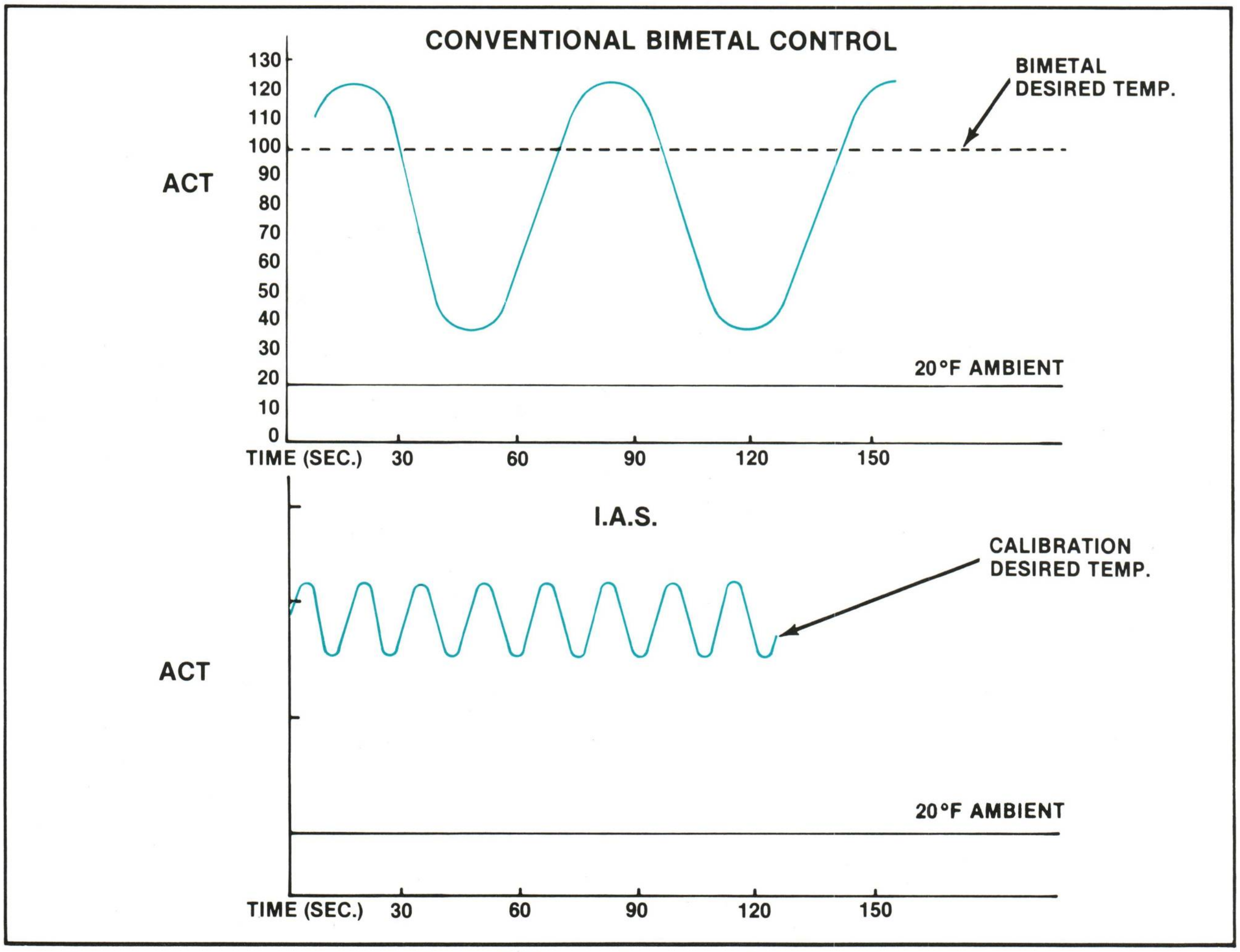


Figure 36. Bimetal Operational Graphs

CURRENT HEATED AIR INLET SYSTEMS

Other improvements that are ongoing are the designs of heat stoves (Fig. 37) over the exhaust manifold for heated air. As you can imagine, there is certainly going to be a difference in the airflow between heated air and ambient air. Heated air must pass between the exhaust manifold and the heat stove before it goes to the air cleaner. Ambient air is simply drawn in through the air cleaner snorkel and fresh air tube assemblies. There is quite a lot more restriction for heated air than for ambient air.

Also, keep in mind the differences between manifold heat stoves on cast iron and tubular exhaust manifolds that were mentioned earlier in the book. Tubular exhaust manifolds will have smaller heat stoves because of their rapid heating properties. Cast iron manifolds will have much larger heat stoves because of their slower heating characteristics.

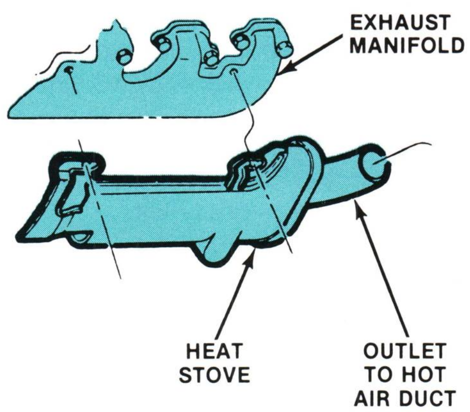


Figure 37. Manifold Heat Stove

As an example, to demonstrate the restriction, when the bimetal temperature sensor is calling for warm air and the operator suddenly goes into a wide open throttle condition, a partial vacuum (depression) can actually develop within the air cleaner assembly (Fig. 38). The depression occurs because the engine cannot get enough air through the heat stove. Once the air cleaner door opens to ambient air, the vacuum is reduced because a sufficient supply of air is available. But to improve cold engine performance, it is important to get as much air as possible to the air filter.

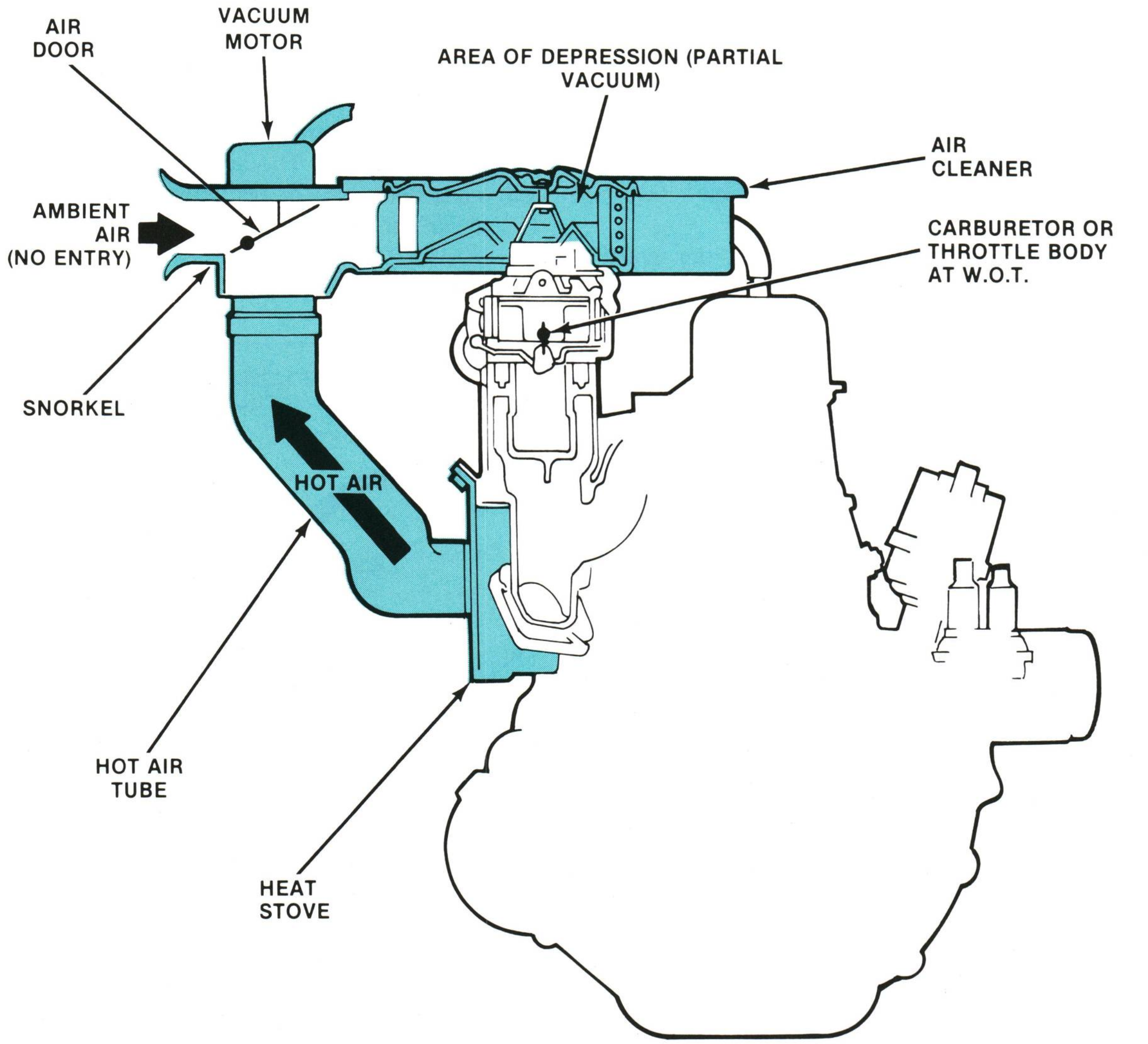


Figure 38. Depression Within Air Cleaner

CURRENT HEATED AIR INLET SYSTEMS

Ford engineers have worked diligently to improve the airflow through the shroud area so that sufficient air is available to the engine in all modes of operation.

There have also been major improvements in the retard delay valves and cold weather modulators. In the past, there have been occurrences where the air cleaner vacuum motor could not overpower the internal vacuum within the air cleaner, which we just mentioned could occur in a wide open throttle condition during cold ambient or cold engine conditions. In such a situation, the air door would be held shut (by the depression) in the warm air position. This would drastically affect performance (adding as much as 6 seconds to 0–60 mph times) because sufficient air was not available.

To prevent this situation from occurring, the retard delay valves and cold weather modulators have been designed to allow the air door to move into the ambient air position as engine load and throttle position increase.

Another component that has been used in some applications is a wide open throttle (W.O.T.) valve (Fig. 39). This device is used to monitor the amount of depression in the air cleaner assembly. If excessive amounts of vacuum are noticed, the W.O.T. valve reacts to bleed trapped vacuum from the vacuum motor, causing the door to open as engine load increases. The use of this valve was to improve the performance of the engine during cold ambient operation, when the air door was in the heated air position. The application of the W.O.T. valve has been used in field fixes explained in TSBs (Technical Service Bulletins).

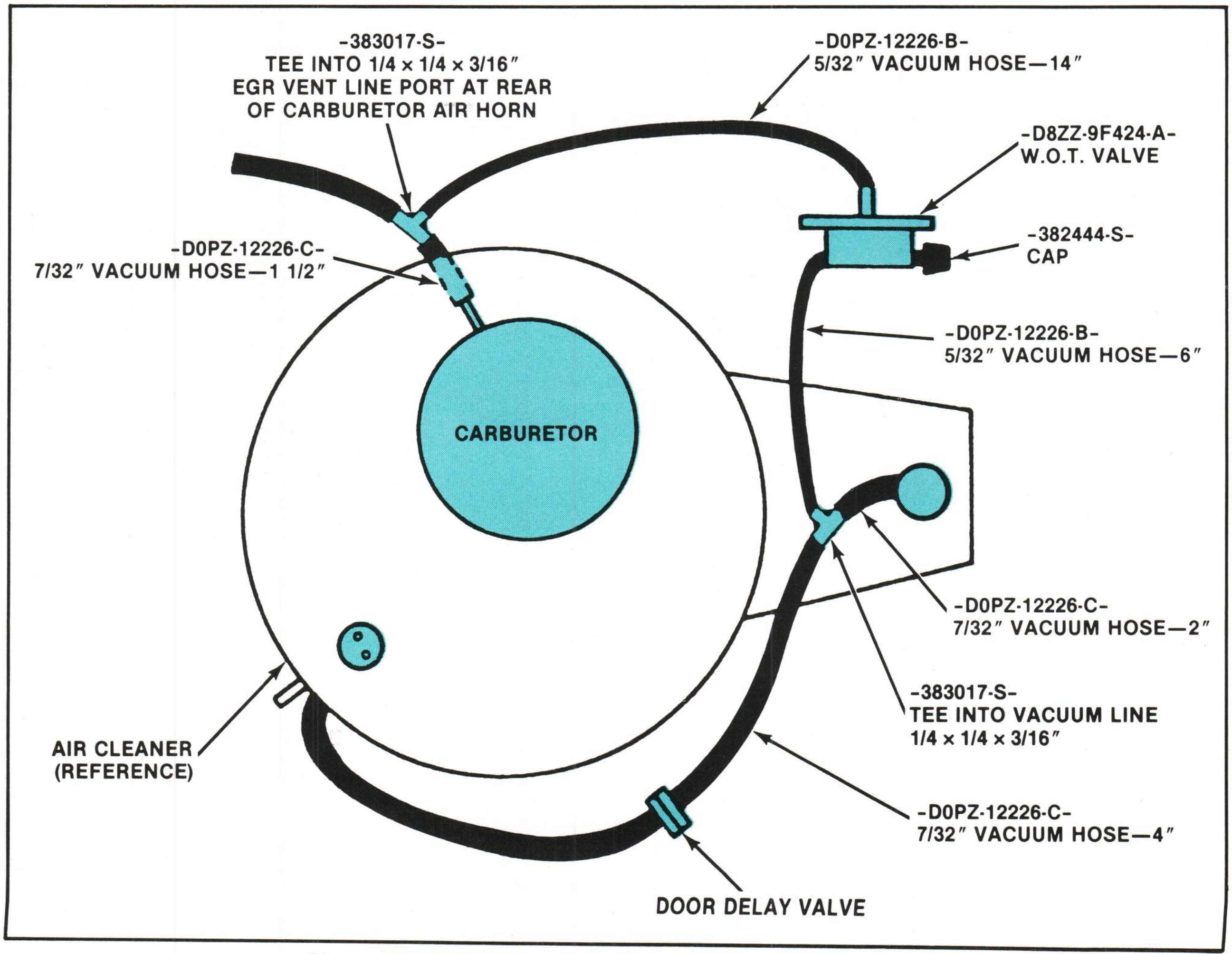


Figure 39. W.O.T. Valve (2.8L Engine Application Shown)

As you've probably already gathered, it is imperative for the system to be able to react rapidly to changes in temperature. No matter how sensitive the components are though, there is still a reaction time for any mechanical type component. To reduce the reaction time, electronics can be used to control the system. This has occurred on the 2.8L engine used in 1985 Ranger/Bronco II applications.

2.8L COMPUTER-CONTROLLED INLET AIR SYSTEM (IAS)

This computer-controlled inlet air system (IAS) (Fig. 40) was only used in the 1985 model year, but it is important to be familiar with it as it is the only electronically controlled heated air inlet system that has been used to date by the Ford Motor Company. The primary reason for using this system was to provide a more consistent inlet air temperature during cruise conditions, wide open throttle function for maximum power requirements, and an improved carburetor inlet warm-up during cold starts.

Certain components were deleted from the system because of the electronics. The deleted components include:

- Bimetal Temperature Sensor
- Retard Delay Valve
- Wide Open Throttle (W.O.T.) Valve

In this system, air cleaner temperature is monitored by the air charge temperature sensor (ACT) mounted in the air cleaner tray. This information is monitored by the EEC processor which in turn controls the inlet air system solenoid (IAS).

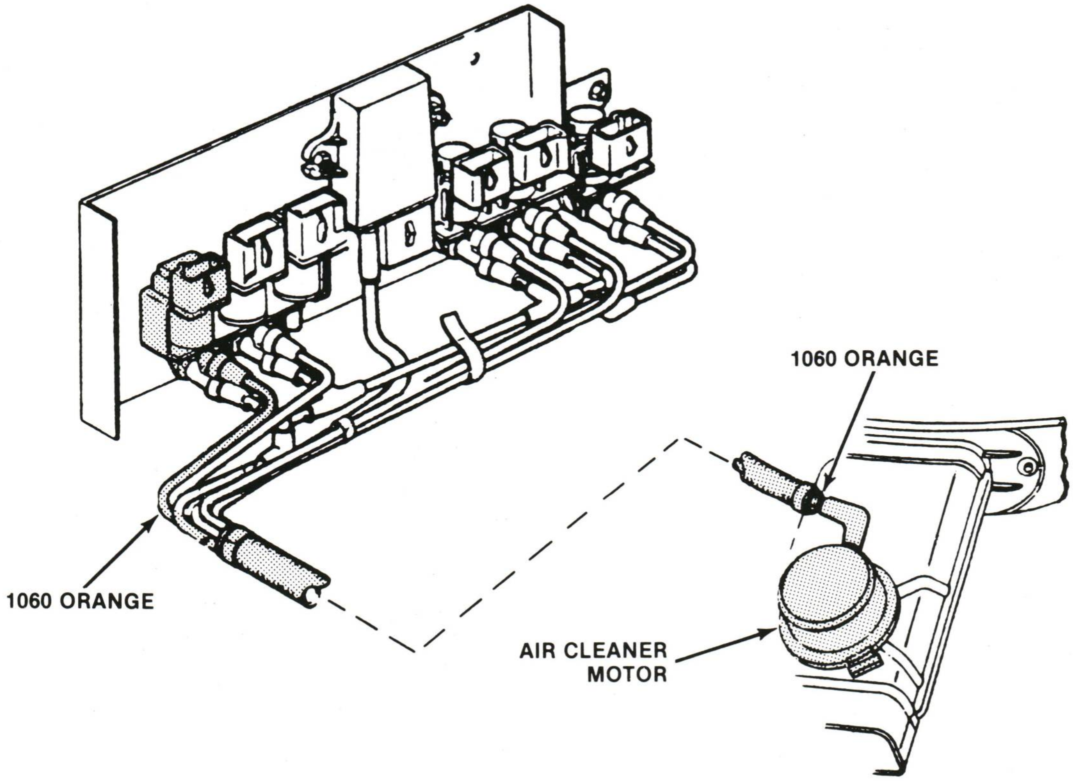


Figure 40. 1985 Computer-Controlled Inlet Air System (IAS)

Operation

When the ECA energizes the IAS solenoid, vacuum flows to the air inlet door vacuum motor closing it to cold air. This allows air heated by the heat stove to enter the carburetor allowing the air-fuel mixture to vaporize more efficiently. The ECA de-energizes the IAS solenoid under the following conditions:

- When the inlet air reaches a certain operating temperature (preset as part of engine calibration).
- If a wide-open throttle condition is signalled by the throttle position sensor (TPS) and engine rpm.

Major Components

The primary components of the system include the IAS solenoid, which is mounted on the cowl, beneath a cover along with other electronically controlled solenoids (Fig. 41). The IAS solenoid directs vacuum to the air control door vacuum motor. Vacuum is supplied to the IAS solenoid by the vacuum reservoir (VRESSER). Routing of the vacuum lines is shown in Figure 42.

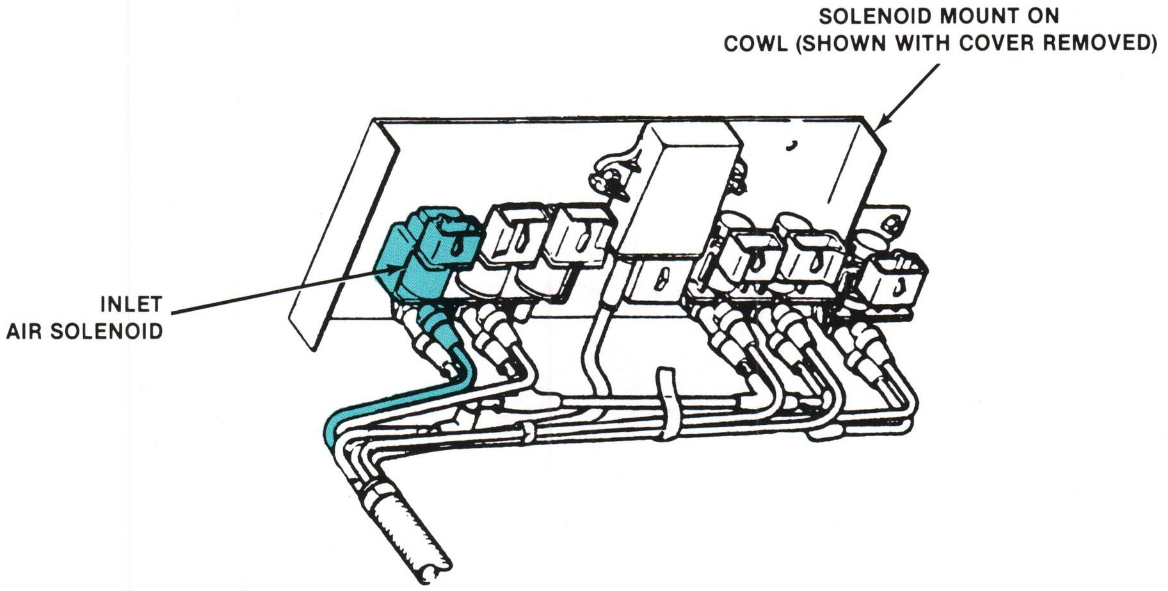


Figure 41. Solenoid Mounting

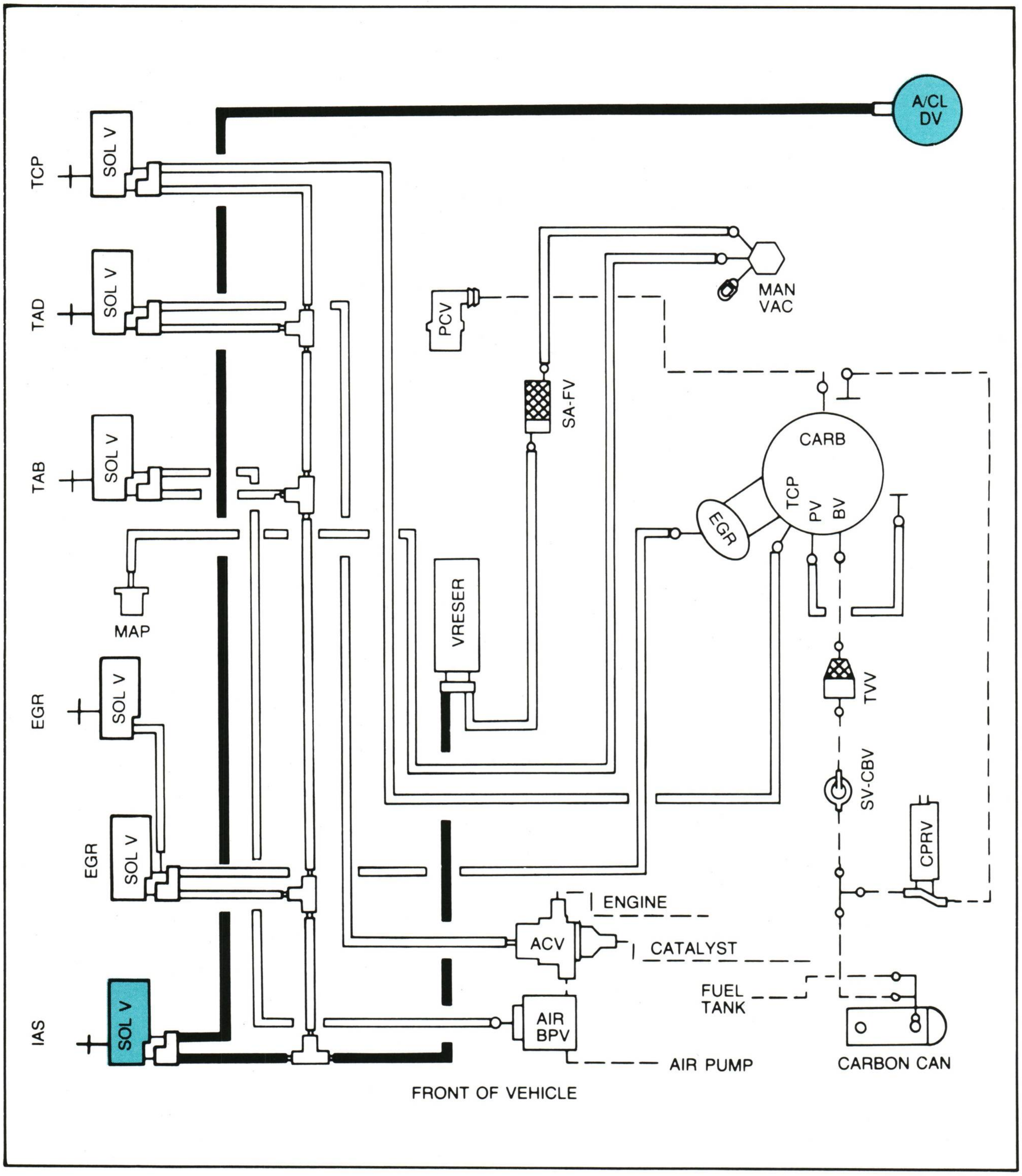


Figure 42. Inlet Air System Vacuum Routing

Processor control of the IAS solenoid is from pin 59 in this particular application (Fig. 43).

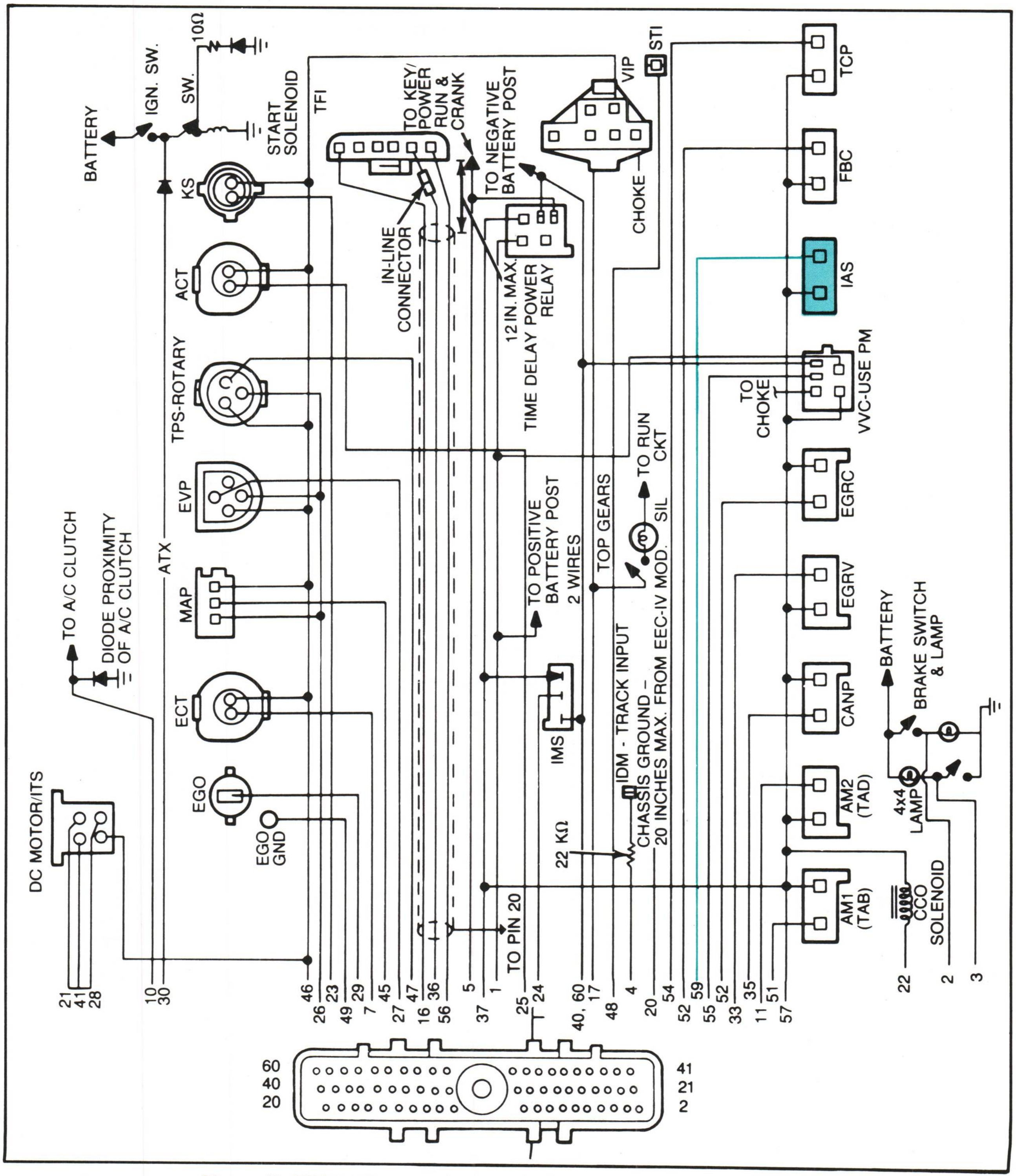


Figure 43. EEC-IV Electrical Schematic For IAS on 1985 2.8L Engine

EFFECT OF INLET AIR SYSTEM ON OTHER SYSTEMS

It is very important for the Heated Air Inlet System to maintain its functional integrity to assure proper engine operation. Malfunctions, damage, or improper modifications in the system can severely affect engine operation in the following areas and conditions:

- Engine Performance
- Fuel Control
- Programmed Choke
- Carburetor Icing and Snow Packing

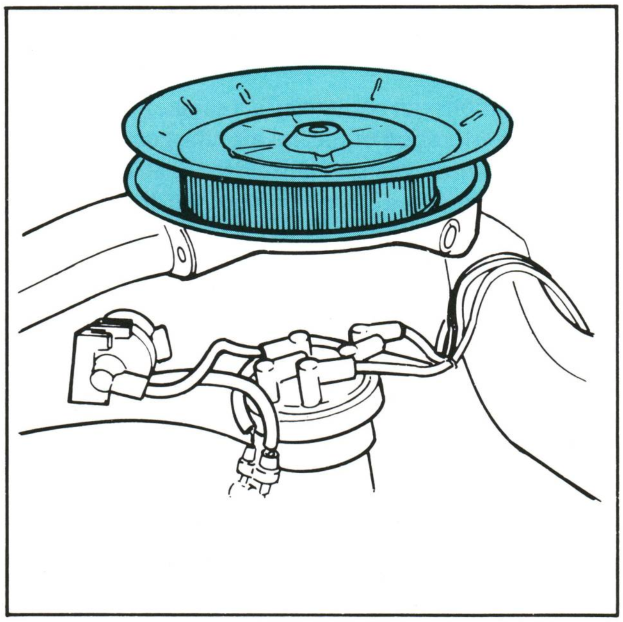


Figure 44. Air Cleaner Cover Turned Upside Down

ENGINE PERFORMANCE

The Heated Air Inlet System is by no means an overly complicated system, but it does play an important role in engine performance, especially during cold engine operation. Proper engine performance depends on the application of warm air or ambient air on an as needed basis as determined by the bimetal sensor or EEC processor (2.8L electronic IAS system).

Any occurrence that prevents proper reading of the air cleaner internal temperature will have a detrimental effect on engine performance during some operating modes. Probably the most common occurrence that prevents accurate monitoring of air cleaner internal temperature is turning the cover of the air cleaner upside down (Fig 44) in the mistaken belief that it will improve airflow and increase performance.

EFFECT OF INLET AIR SYSTEM ON OTHER SYSTEMS

Owner "modifications" such as this definitely hurt performance. Because the system cannot get heated air to the air cleaner, cold engine performance and performance during cold ambient conditions is impaired.

Other situations can occur to affect engine performance such as deterioration of the hot air tube going from the heat stove on the exhaust manifold to the air cleaner. As the tube ages, it may begin to tear, get holes in it or become leaky, allowing cold ambient air to mix with the heated air going into the air cleaner. It is imperative that this does not occur. The hot air tube **must be present** and in good condition for the system to function properly.

Improper operation of the Heated Air Inlet System can also impair engine performance in the event that the air door sticks in the warm air or ambient air position. Obviously if the air door sticks in the ambient air position, heated air will not be allowed into the air cleaner which will affect cold engine and cold ambient air operation.

Should the air door stick in the heated air position, cold engine performance will be normal, but once the engine warms up, performance will suffer, usually in the form of sluggish response, spark knock, and generally poor performance.

Normally a failed air door will stick in the ambient air position. It is quite uncommon for the air door to stick in the heated air position, but it can occur.

FUEL CONTROL

Because the heated air inlet system controls the flow of air into the air cleaner, any problems within the system will affect the fuel-air ratio. Any deviation in the fuel-air ratio can affect driveability because the systems are all calibrated to operate as one integral system.

EFFECT OF INLET AIR SYSTEM ON OTHER SYSTEMS

VARIABLE VOLTAGE (PROGRAMMED) CHOKE

Some engines, most notably the 2.8L engine used in the 1984–85 Ranger/Bronco II and 1986 Aerostar, that are equipped with a Variable Voltage (Programmed) Choke (Fig. 45) controlled by the EEC processor, can have their performance impaired by a problem with the heated air inlet system. To understand why a problem might occur, one must be familiar with the operation of the programmed choke.

Essentially, the programmed choke receives a varying voltage signal from the EEC processor that heats the bimetal spring in the choke cap. As it warms, the bimetal spring expands and opens the choke plate. The amount of voltage pulsed to the choke cap determines how quickly the choke releases. The amount of voltage provided to the choke cap is based on two parameters:

- Engine coolant temperature
- Air inlet temperature

The processor takes into account these two temperatures and determines how much voltage to send to the choke cap. Should the air inlet temperature be cold, caused by a malfunction in the heated air inlet system, the amount of voltage will be lowered or the time it is applied will be limited to allow the choke to stay on longer.

Because the choke is staying on too long, driveability problems such as stumble and poor performance can develop along with smoking, odor, and other conditions that are evident from a fuel-air mixture that is too rich.

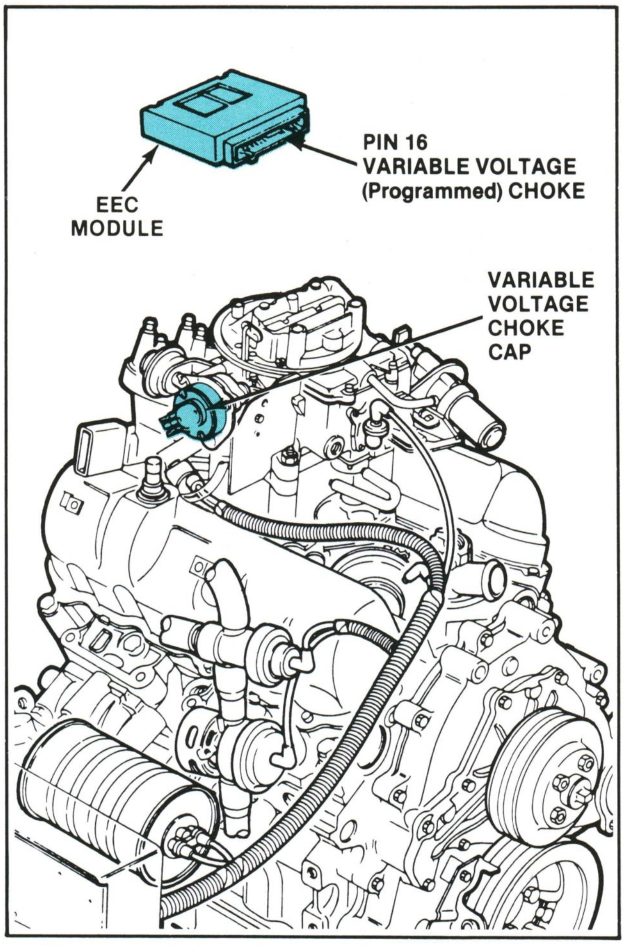


Figure 45. Variable Voltage (Programmed) Choke

CARBURETOR ICING AND SNOW PACKING

As stated at the beginning of this manual, one of the first reasons for developing the heated air inlet system was to reduce carburetor icing and snow packing. Should a problem develop in the heated air inlet system where warm air cannot reach the carburetor, icing or snow packing could become a problem.

Snow packing is phenomenon that is easily understood, as it occurs when snow packs into the air intake and air is not allowed through. As we stated earlier, design changes in the air intake, such as placement in the fenderwell or using shields, have been used to prevent snow packing from occurring. Carburetor icing, though, is an occurrence that is not easily seen and may be hard to diagnose.

Carburetor icing (Fig. 46) occurs during high humidity in temperatures that are hovering near freezing, but can be **above** freezing. What occurs in carburetor icing is:

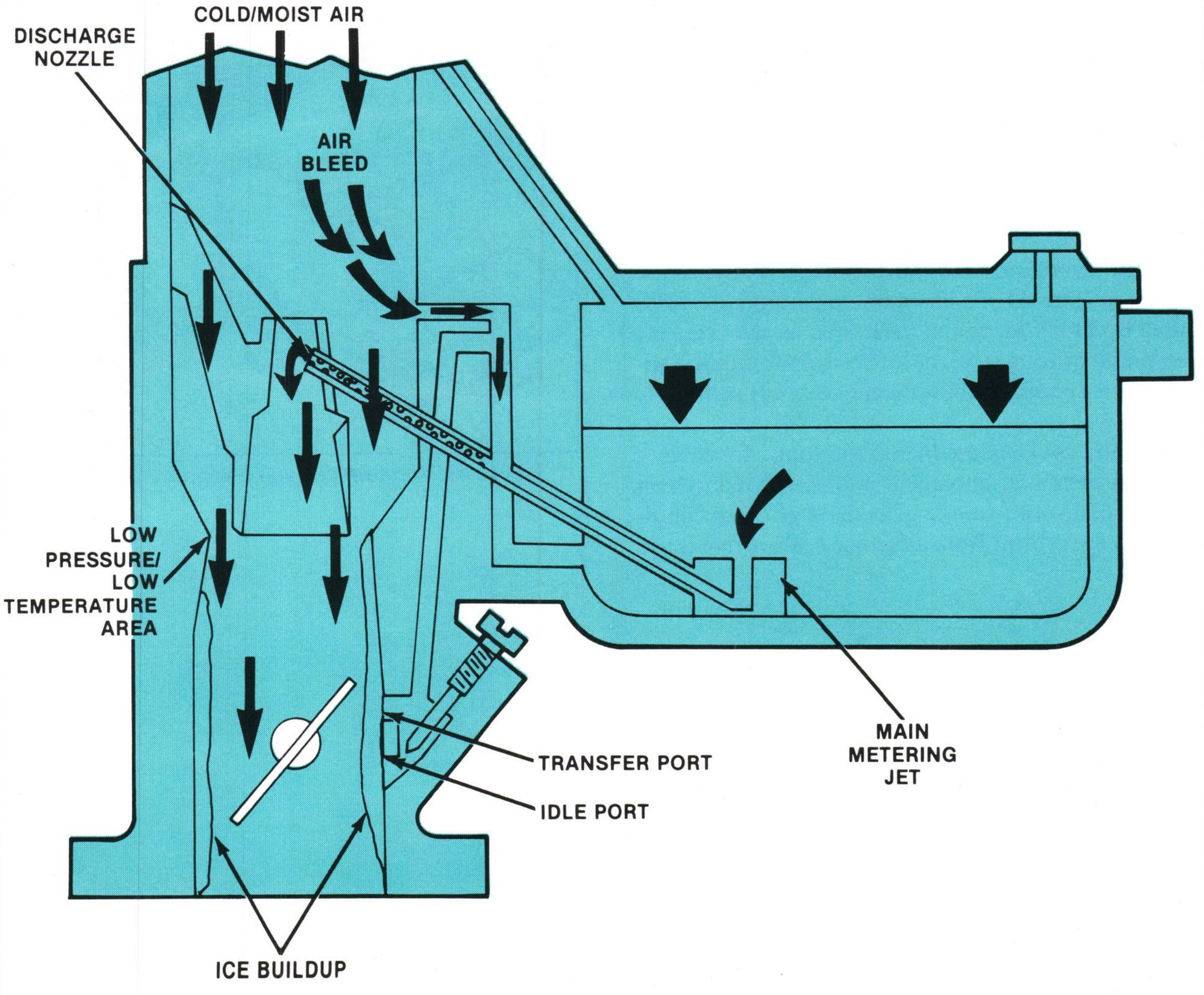


Figure 46. Carburetor Icing

EFFECT OF INLET AIR SYSTEM ON OTHER SYSTEMS

- Air moves through the carburetor venturi. Inside the venturi, air is accelerated and pressure drops.
- With the drop in pressure, air temperature also drops. With the drop in temperature, water vapor contained in the air condenses on metal surfaces.
- The drop in temperature may actually place the surface of the metal below freezing, causing ice to form on its surface.
- As the ice builds up, it blocks off the idle ports.
- When the engine returns to idle, the idle port is blocked by ice and the engine stalls. Once the engine stalls, airflow through the carburetor stops, and engine heat moves up, melting the ice. Normally the engine is able to start within minutes. Should someone take a look for ice, it has normally disappeared before the top of the air cleaner is removed.

Should you run into a complaint of stalling or hard starting and you suspect carburetor icing, check the heated air inlet system for proper operation.

SYSTEM SERVICE

Too often in driveability or poor performance complaints the heated air inlet system is overlooked as a possible source of the problem. Should a problem with the heated air inlet system arise, it is most likely caused by one of the following problems:

1. Obstructions to airflow, causing hard starting, performance problems and poor fuel economy.
2. Vacuum loss, causing cold driveability problems; since the system goes to full fresh air.
3. Air leaks which "bypass" the control and usually cause cold driveability problems.
4. Failure of the vacuum trap (cold weather modulator or retard delay valve) which can cause stumble on cold acceleration because the engine is provided with ambient air too quickly.

To determine if there is a problem in the heated air inlet system, use the following summary to help you in your diagnosis of the system.

IN THESE CONDITIONS	THE RESULT IS	THE SYMPTOM CAN BE
Debris in snorkel or air door Collapsed air duct Dirty air filter	Restricted airflow	Cranks normal and starts hard Hesitates or stalls on acceleration Lack of power Poor fuel economy
Vacuum leak Bimetal stuck in bleed-off Vacuum motor diaphragm leak Air door stuck open	Fresh air only is available (no heated air)	Hesitates on cold acceleration Lack of power Poor fuel economy
Heated air duct leaking or not installed Air cleaner not sealed tight Broken or leaking duct or air cleaner	Fresh air leaks into system (some or no heated air)	Warm driveability problems in cold ambient air conditions
Air door stuck open Sensor fails to bleed off when it warms	Too much heated air; no fresh air	Lack of power in warm engine May overheat May detonate
Check valve leaks in cold weather modulator Retard delay valve leaks	No vacuum trap to air door motor (at full throttle)	Poor acceleration cold Hesitates or stumbles on acceleration

SYSTEM INSPECTION AND PERFORMANCE TEST

System Inspection

1. Apply the parking brake and block the wheels.
2. Remove the air cleaner cover and element. Inspect the heated air duct for proper installation and/or damage. Service the duct if required.
3. Remove components as necessary to ensure that the duct door is in the open to fresh air position (ambient air is allowed in). If the door is in "heated air" position, meaning it's closed off ambient air, check for binding and/or sticking of the air door. Service or replace the vacuum motor/air door assembly as required.
4. Check the vacuum source and condition of the vacuum hoses to the bimetal sensor, cold weather modulator or retard delay valve, and vacuum motor. If any of the vacuum hoses show signs of damage or deterioration, replace them.

NOTE: On 2.8L engines equipped with the electronically controlled inlet air system, check the vacuum hoses from the vacuum reservoir to the IAS solenoid and from the IAS solenoid to the vacuum motor.

Performance Test—Mechanical System

NOTE: The ambient air must be at least 60 °F (16 °C)for the following test to be accurately performed.

5. Start the engine. If the air door moves to the heated air position (closed to ambient air) go to Step 7. If the door stays in the ambient air position (closed to heated air), place a finger over the bleed of the bimetal temperature sensor (Fig. 47). The air door must move rapidly to the heated air position. If the door does not fully move to the heated air position, stop the engine and test the vacuum motor. Repeat the test with a new or known good vacuum motor.

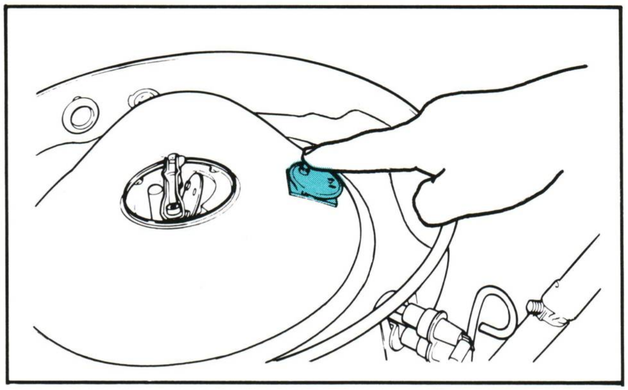


Figure 47. Placing Finger Over Vacuum Bleed

6. With the engine off, cool the bimetal temperature sensor and cold weather modulator (if equipped) by spraying them with refrigerant R-12 (Fig. 48). Spray them for 20 seconds after the liquid contacts the sensor and cold weather modulator.

NOTE: If a small can of R-12 is available, use it along with adapter ZRE-6271 or equivalent, to cool the bimetal sensor.

CAUTION: Do not cool the bimetal temperature sensor or cold weather modulator while the engine is running. Should R-12 be drawn into the engine it will burn and poisonous phosgene gas will be exhausted into the test area. Perform this test only in a well-ventilated area.

Restart the engine. The air duct door should move to the heated air position. If the door does not move or moves only partially, replace the sensor. With a new sensor in place, cool the new sensor and the cold weather modulator.

7. Start and run the engine briefly (less than 15 seconds). The duct door should move to the heated air position.
8. Shut off the engine and observe the duct door:
   a. Vehicle with a retard delay valve: Air door will return slowly to the ambient air position (10 to 30 seconds).
   b. Vehicles with cold weather modulator: Air door will stay in the heated air position for at least two minutes. If less than two minutes, replace the cold weather modulator and repeat this step after again cooling the cold weather modulator and bimetal temperature sensor.

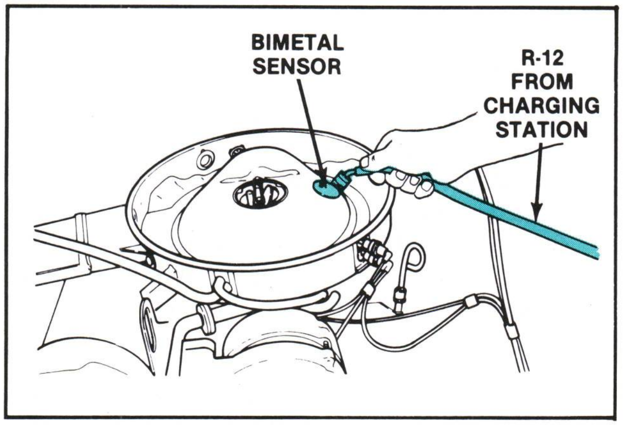


Figure 48. Cooling the Bimetal Temperature Sensor

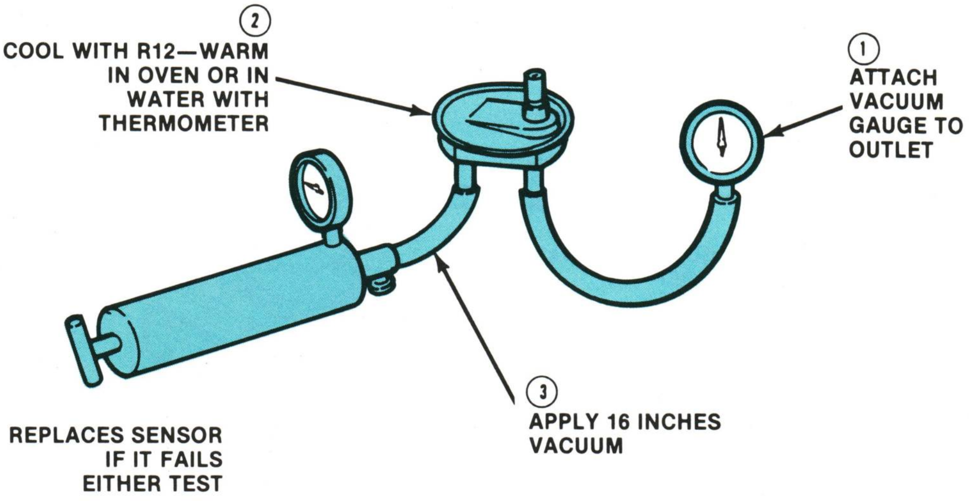
INDIVIDUAL COMPONENT TESTING

Air Cleaner Bimetal Temperature Sensor

The air cleaner bimetal temperature sensor is vacuum-checked in both warm and cold conditions using a vacuum pump. Use the following procedure (Fig. 49).

HOW TO TEST THE AIR CLEANER BIMETAL SENSOR

- Test in or out of air cleaner housing.
- Must have specified vacuum output at both temperatures in chart.
- Engine off before cooling with refrigerant. **Wear goggles.**


②
COOL WITH R12—WARM IN OVEN OR IN WATER WITH THERMOMETER
①
ATTACH VACUUM GAUGE TO OUTLET
③
APPLY 16 INCHES VACUUM
REPLACES SENSOR IF IT FAILS EITHER TEST

COLOR CODE	TEMP. SETTING	VACUUM OUTPUT WITH 16 IN. HG. AT SOURCE	BLEED SETTING	VACUUM OUTPUT WITH 16 IN. HG. SOURCE
BROWN	75° F	1-5 IN. HE.	40° F	11 IN. HG
PURPLE, BLACK	90° F		55° F	
GREEN, YELLOW	105° F		70° F	
PINK	90° F	4-9 IN. HG.	65° F	
BLUE	105° F		80° F	

Figure 49. Air Cleaner Bimetal Temperature Sensor Test

Air Door Vacuum Motor

Check the operating integrity of the air door using a vacuum pump and the following procedure (Fig. 50):

HOW TO TEST THE AIR DOOR VACUUM MOTOR

- Must pull in and stay in two minutes with vacuum trapped.
- Must move out and open air door when vacuum is released.

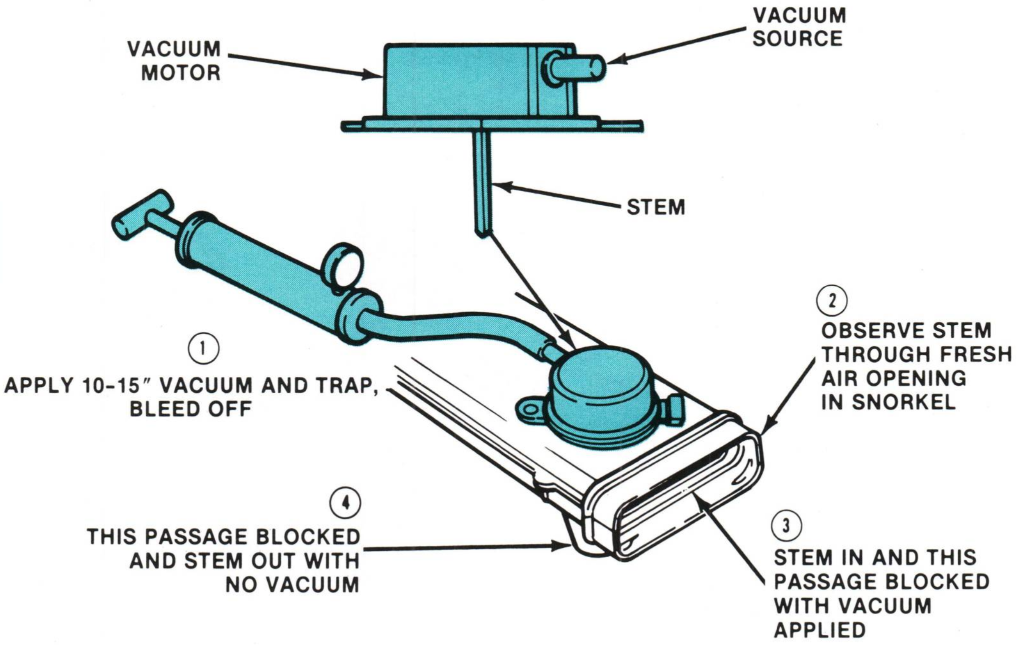
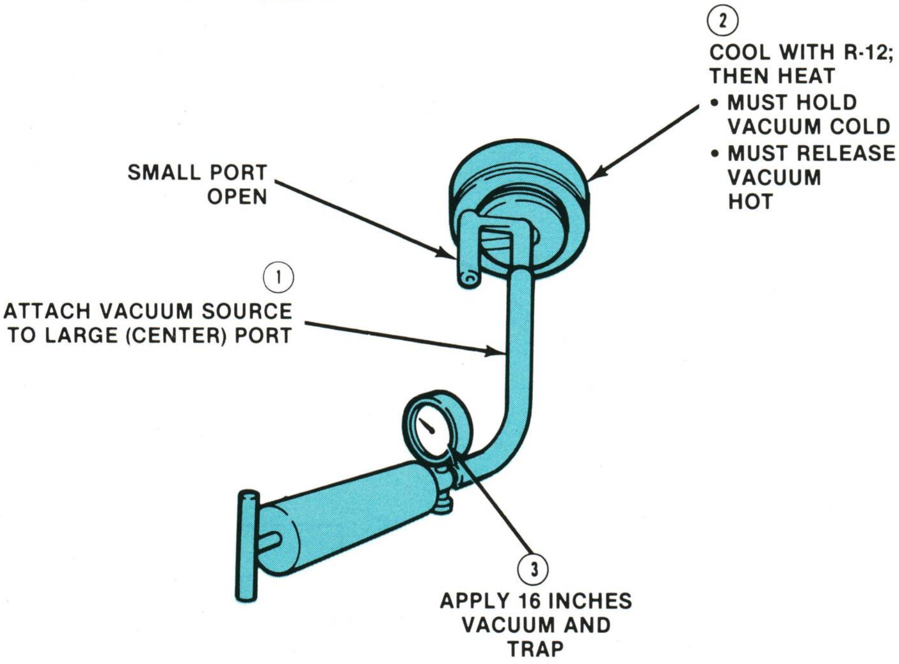

VACUUM MOTOR
VACUUM SOURCE
STEM
②
OBSERVE STEM THROUGH FRESH AIR OPENING IN SNORKEL
①
APPLY 10-15″ VACUUM AND TRAP, BLEED OFF
④
THIS PASSAGE BLOCKED AND STEM OUT WITH NO VACUUM
③
STEM IN AND THIS PASSAGE BLOCKED WITH VACUUM APPLIED

Figure 50. Testing the Air Door Vacuum Motor

Cold Weather Modulator

Testing the cold weather modulator requires cooling it as previously described and checking it with a vacuum pump. Use the following procedure (Fig. 51):



HOW TO TEST THE COLD WEATHER MODULATOR

- Test in or out of air cleaner housing.
- Engine off before cooling with R-12. **Wear goggles.**

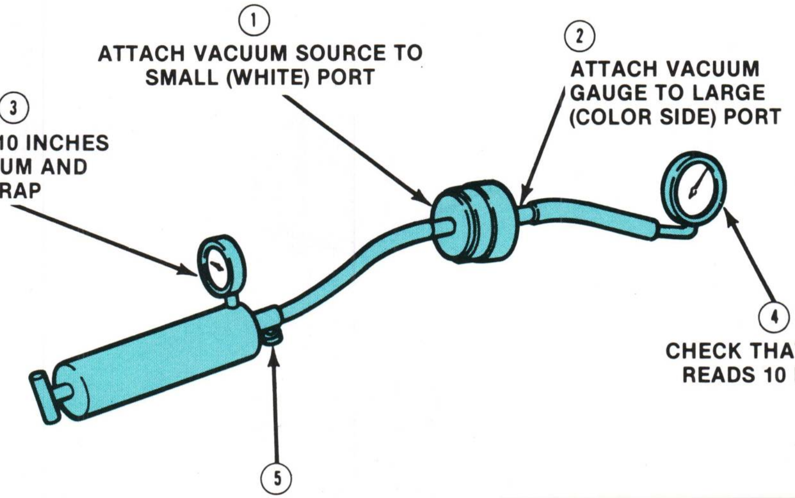
② COOL WITH R-12; THEN HEAT
• MUST HOLD VACUUM COLD
• MUST RELEASE VACUUM HOT
SMALL PORT OPEN
① ATTACH VACUUM SOURCE TO LARGE (CENTER) PORT
③ APPLY 16 INCHES VACUUM AND TRAP

Figure 51. Testing the Cold Weather Modulator

Retard Delay Valve

Testing a retard delay (Fig. 52) requires the use of a vacuum pump and a vacuum gauge to measure the amount of time it takes the vacuum to bleed down. Use the following procedure to perform the test:

HOW TO TEST THE RETARD DELAY VALVE



① ATTACH VACUUM SOURCE TO SMALL (WHITE) PORT

② ATTACH VACUUM GAUGE TO LARGE (COLOR SIDE) PORT

③ APPLY 10 INCHES VACUUM AND TRAP

④ CHECK THAT GAUGE READS 10 INCHES

⑤ OPEN BLEED VALVE TO RELEASE

COUNT SECONDS IT TAKES TO DROP FROM 8 INCHES TO ZERO VACUUM. COMPARE WITH TABLE.

COLOR	DELAY TIME (SECONDS)
RED	15-28
BLUE	9-20
PINK	4-12

REPLACE VALVE IF IT FAILS STEP 4 OR 5

Figure 52. Retard Delay Valve Test

COMPONENT REPAIR

Servicing the components of the heated air inlet system is limited to component replacement. There are no adjustments or periodic maintenance points in this system.

GLOSSARY

AMBIENT TEMPERATURE—(1) The temperature of air in its natural state in a given location. (2) In automotive terminology it normally refers to the temperature of the air surrounding the vehicle or engine.

BIMETAL TEMPERATURE SENSOR—Air cleaner-mounted temperature sensor that senses the temperature of the air within the air cleaner. The sensor is made up of two strips of metal attached to each other that have different expansion rates. The metal strip bends toward the metal that expands least when heat is applied.

BLEED—A device to release vacuum at a controlled or properly timed rate.

CARBURETOR ICING—A term used to describe the formation of ice crystals in the venturi bores of a carburetor.

CENTRAL FUEL INJECTION (CFI)—A fuel injection system using injector(s), computer-controlled, spraying fuel into the venturi bores of a throttle body.

CHOKE—Device used on the carburetor to restrict the flow of air into the engine during starting so that a rich mixture of fuel enters the engine. This eases starting and improves cold weather operation.

COLD WEATER MODULATOR—A temperature vacuum switch mounted on the air cleaner housing that holds vacuum on the vacuum motor in the event there is a sudden drop in manifold vacuum. It is used only during cold ambient conditions.

DEPRESSION—An area of partical vacuum.

EARLY FUEL EVAPORATION HEATER (EFE)—A grid-type heater which heats fuel discharged from the carburetor for better vaporization when the engine is cold.

FRESH AIR DUCT—Duct leading from the air inlet to the snorkel of the air cleaner. The duct conducts fresh, ambient air to the air cleaner. Also called a "zip tube."

HEAT STOVE—Shroud placed over the exhaust manifold to trap heat. Ambient air is drawn between the shroud and manifold to heat it during cold ambient or cold engine conditions.

HOT AIR TUBE—Tube, often made of treated paper (on older cars it is made of metal) which conducts hot air from the manifold heat stove to the air cleaner.

INLET AIR SOLENOID—Solenoid used on the 1985 2.8L Ranger/Bronco II application which controlled the operation of the vacuum motor on the air cleaner.

INLET AIR SYSTEM (IAS)—Computer-controlled system used on the 1985 2.8L Ranger/Bronco II models that controlled the admission of heated and ambient air into the air cleaner.

MODULATE—The movement of regulation of a device in response to differing pressures or forces acting upon it.

PORT FUEL INJECTION (EFI)—A fuel injection system, computer-controlled, which has multiple fuel injectors, one at each port. These injectors direct fuel directly into the intake port.

PROGRAMMED CHOKE—A special choke which is controlled by the EEC IV processor. The processor pulses voltage to the choke to determine the speed at which it opens. The two parameters that determine the timing of the choke opening are coolant temperature and inlet air temperature.

RETARD DELAY VALVE—A valve used to slow the bleed off or application of vacuum to or from a component to prevent an abrupt movement, fast release, or quick application.

WIDE OPEN THROTTLE (W.O.T.) VALVE—Valve which senses engine load and throttle opening and bleeds off vacuum to the vacuum motor when there is a depression in the air cleaner. This condition would most likely occur during a wide open throttle situation.

ZIP TUBE—Another name for "fresh air duct."

NOTES

NOTES

ASE
CERTIFIED ™

WE SUPPORT VOLUNTARY TECHNICIAN CERTIFICATION

January, 1989   Litho in U.S.A.   Order No. 0900-025-STST